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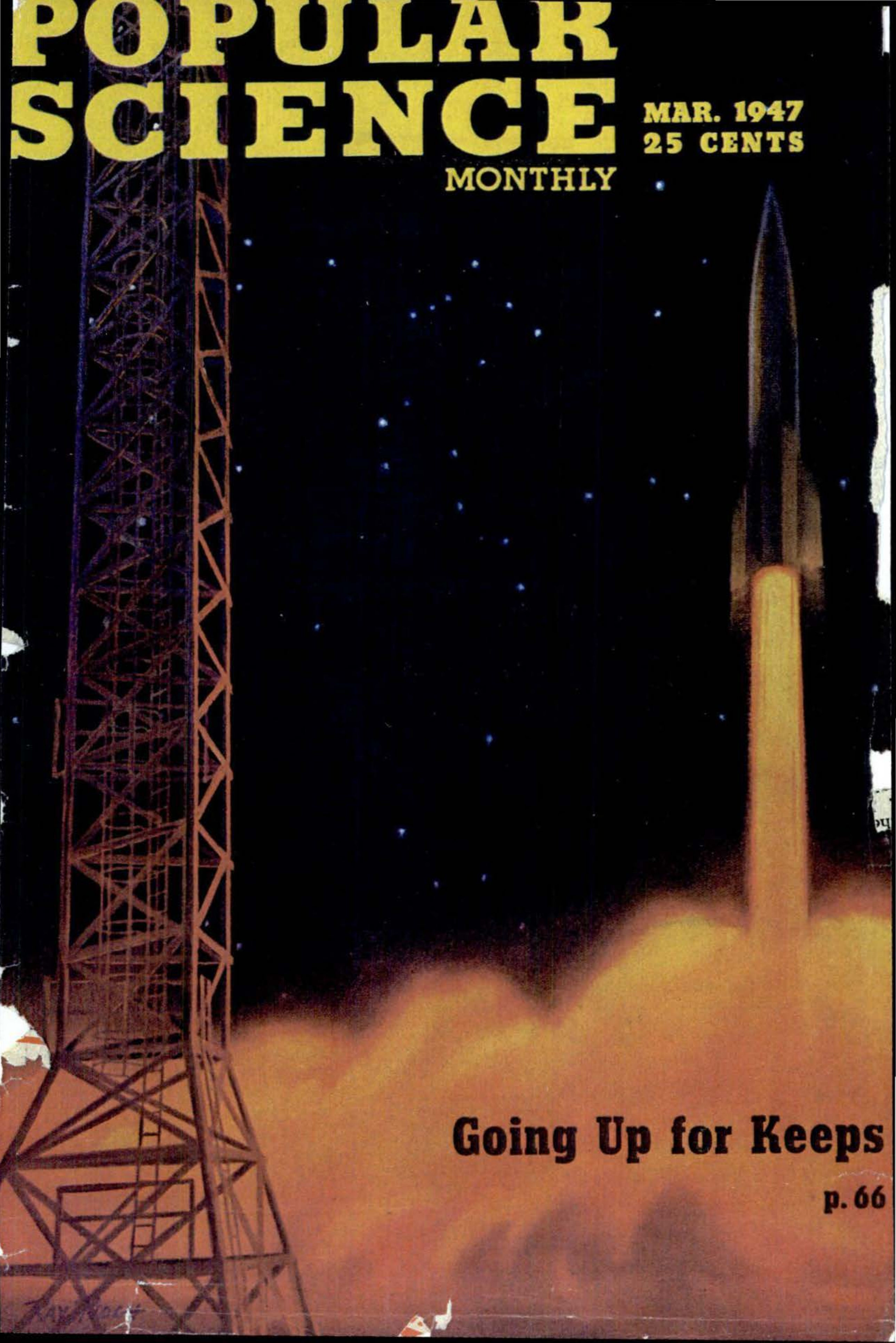

Going Up for Keeps

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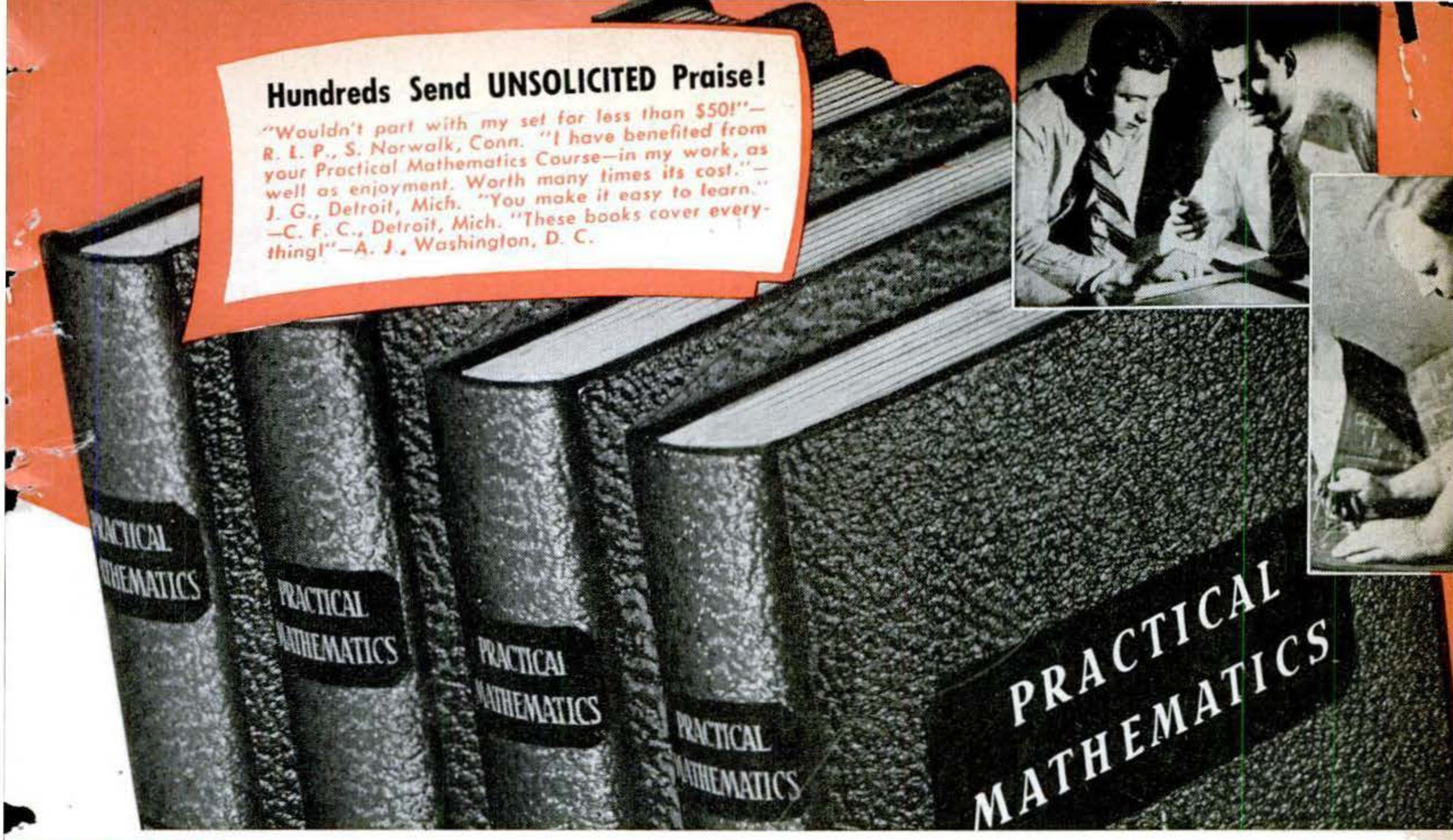

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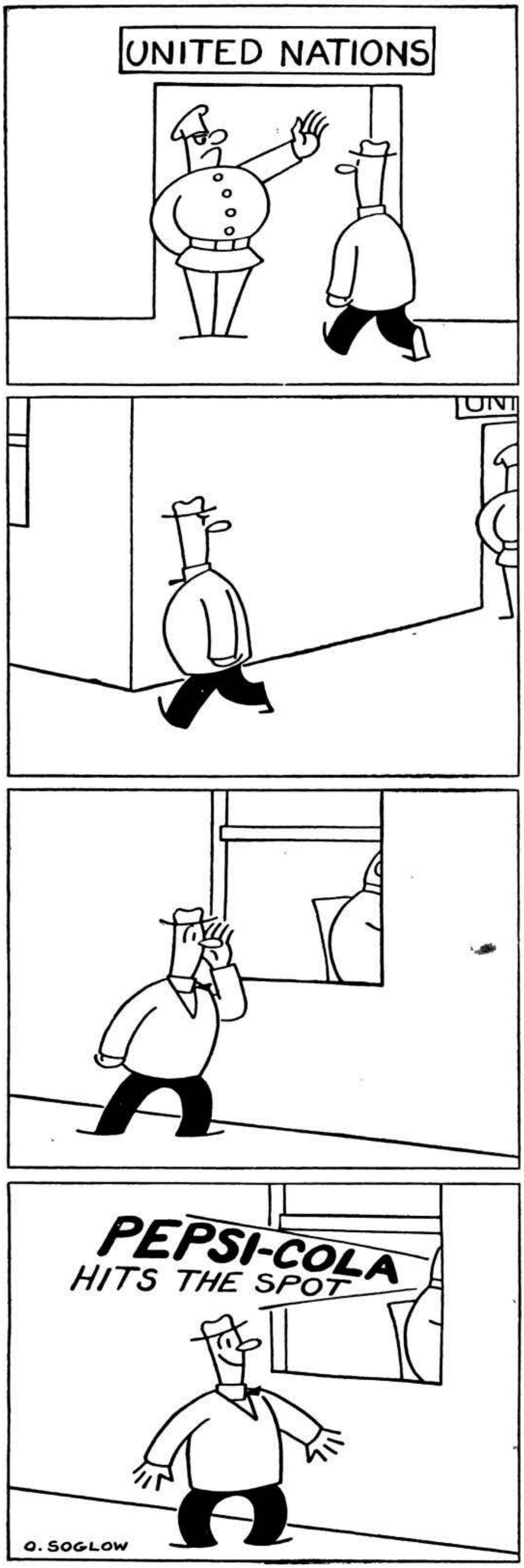

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Today Bell Telephone Laboratories have turned the dream into a fact—translating the spoken word into readable pictures.

By this new invention of the Laboratories, the talker speaks into a microphone. Vibrations of the voice are unraveled through electronic circuits, and then are reassembled as luminous patterns which travel across a screen. Each syllable of sound has a distinctive shape and intensity.

Visible speech is still in its infancy, and is not yet available to the public. But educators of the deaf are now evaluating it.

Science unravels speech

Indications are that the deaf can learn to read the patterns and, by comparing the patterns their own voices make with the patterns of correct speech, can improve their diction.

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages. Eventually, visible speech may make possible visual telephony for the deaf.

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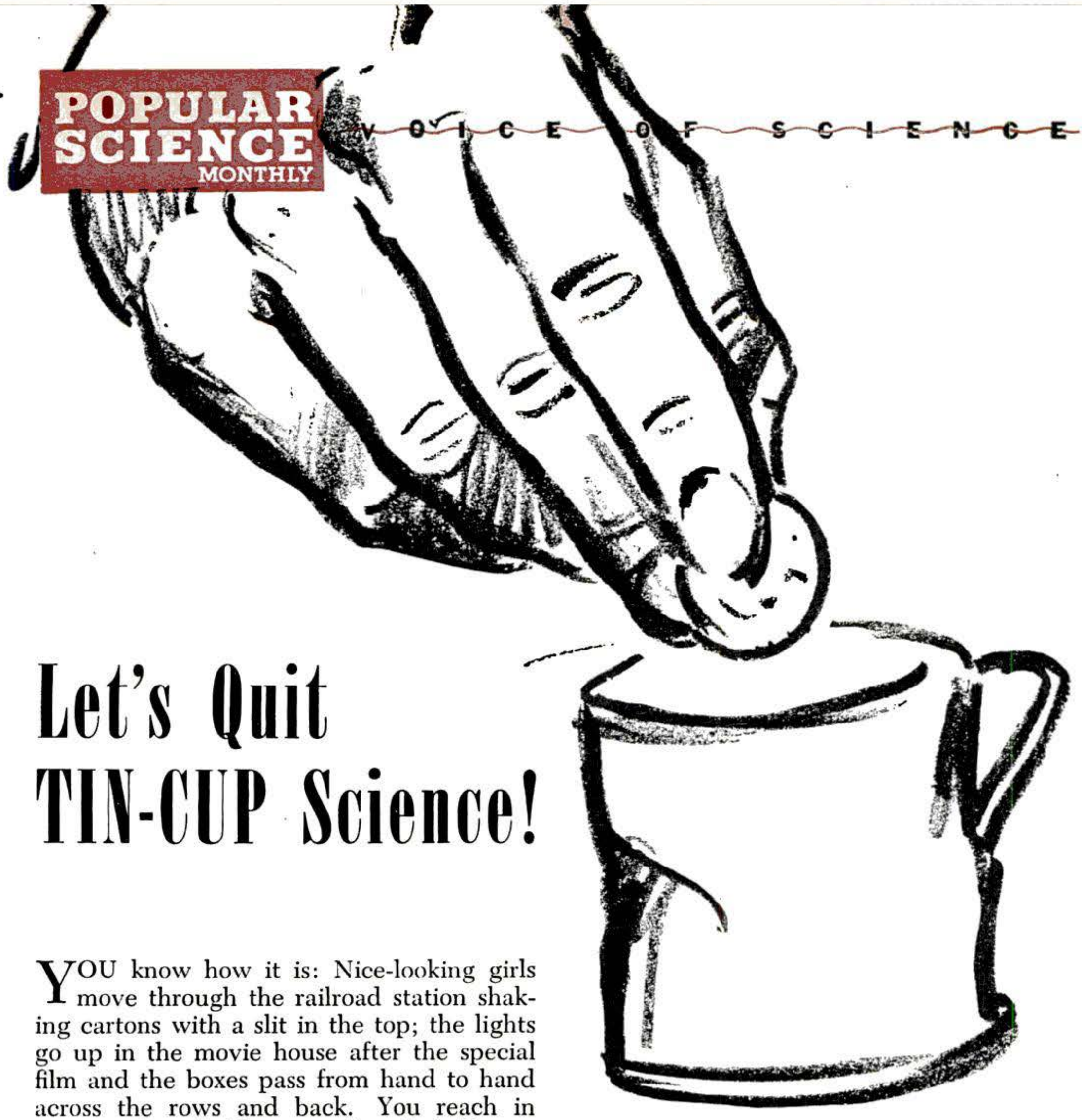

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YOU know how it is: Nice-looking girls move through the railroad station shaking cartons with a slit in the top; the lights go up in the movie house after the special film and the boxes pass from hand to hand across the rows and back. You reach in your pocket, half annoyed and half embarrassed, and wonder how much is enough.

Infantile paralysis, tuberculosis, cancer—the causes are worthy. Millions in loose change and fat checks (solicited from the "special lists" and tax-deductible) come out of the drives. Millions well spent to allay some of the suffering.

Every year, more millions come out of the big tin cup. But not enough: Last year, 500,000 Americans had tuberculosis, 720,000 had cancer and new infantile paralysis cases reached a peak of more than 25,000. Apparently, public health is too big for private charity.

This is not a plug for socialized medicine. But it is a plea for peacetime Congressional action as big and bold as wartime government action. If there is one good thing we have learned from the war, it is that big problems demand the big approach. Radar, guided missiles, loran were big problems solved the big way. And, of course, there was the biggest of all, nuclear fission, in which sheer brains and bucks tore the mortal secret from the atom.

It has been said that, handled in the wartime way, tuberculosis certainly could be wiped out in mere years. Research in such force naturally costs a lot of money. However, science now knows how to spend money to save time. And time means lives—maybe your own.

But until Congress, which represents *you*, recognizes the bigness of the problem and reaches into your pocket for the cost of the cure, you had better keep reaching yourself—and reach deep! Tin-cup science isn't too good, but it's all you've got.

Perry Gilkeson

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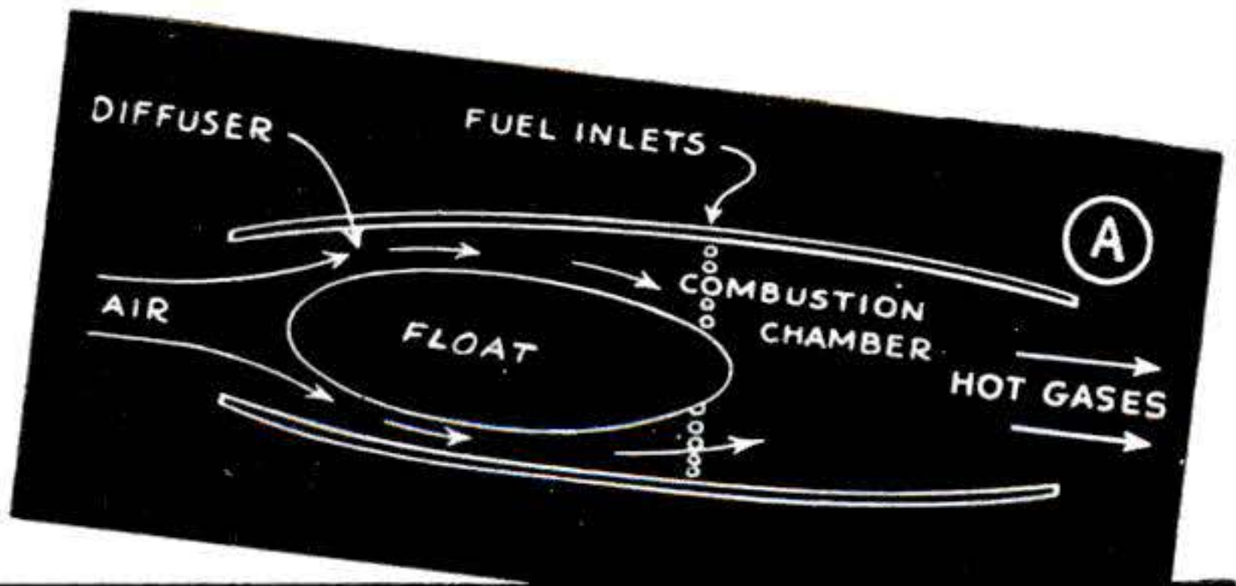
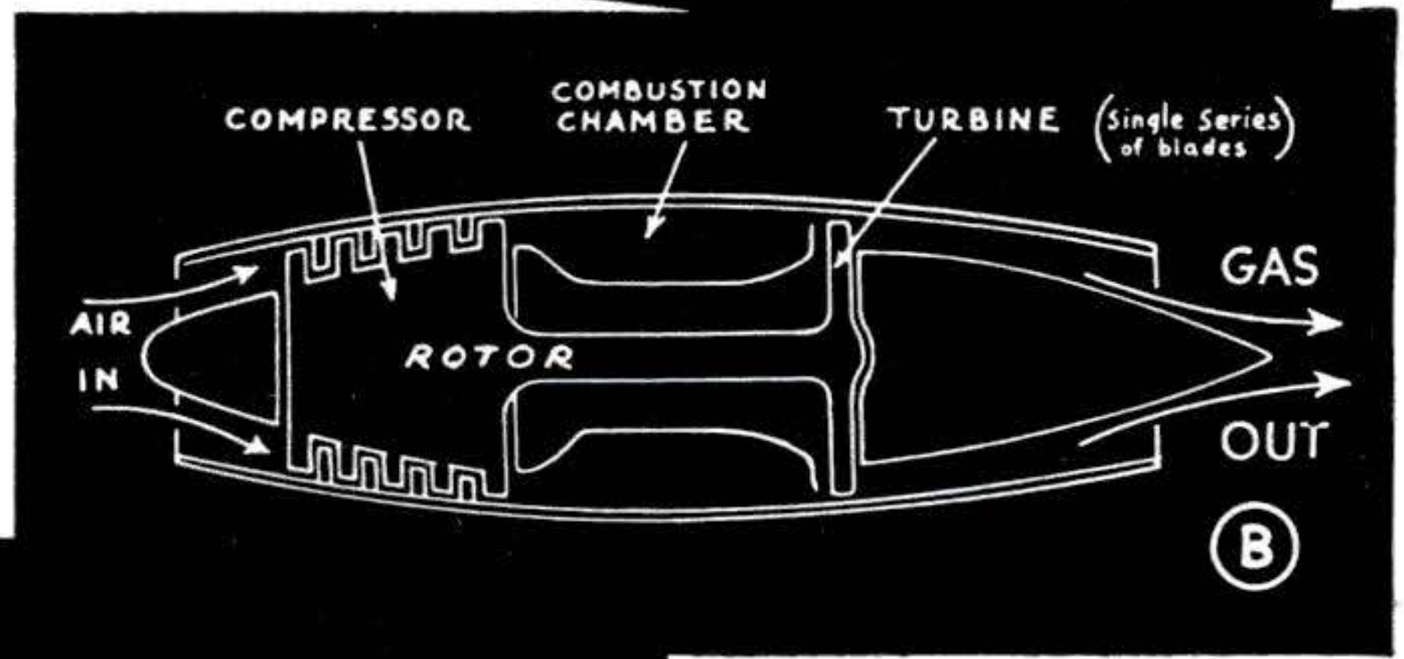
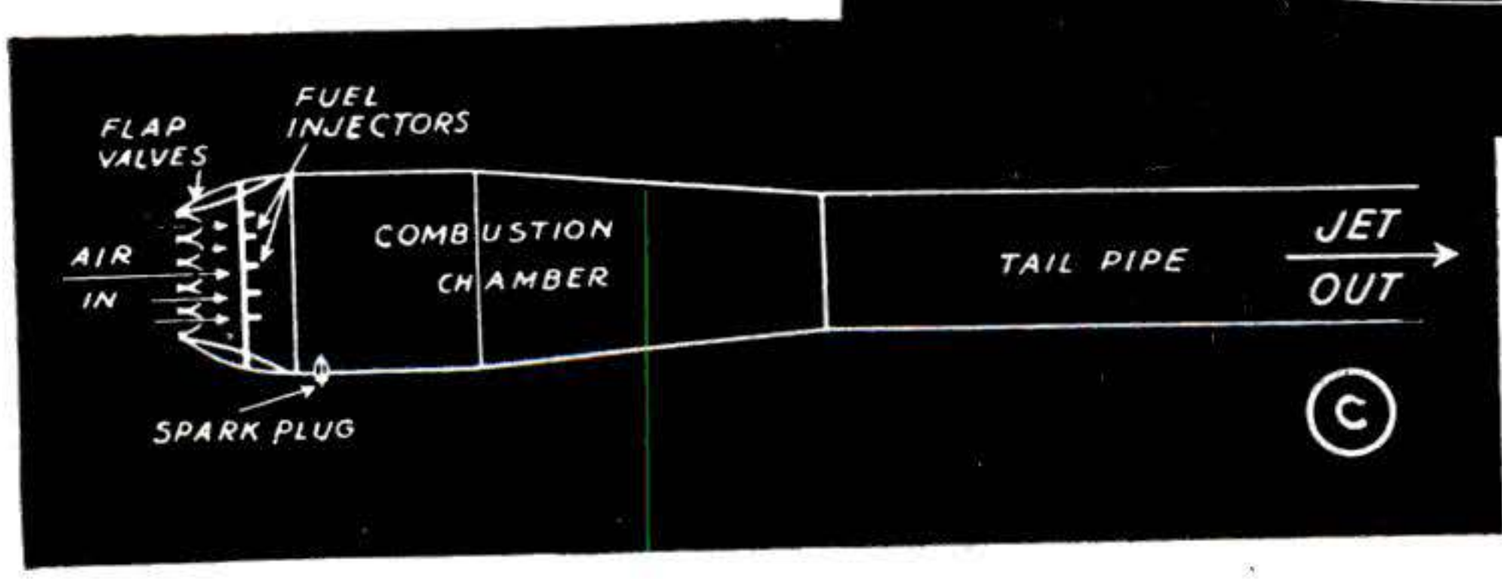
JET PROPULSION?







A. ***RAMJET***

B. ***TURBOJET***

C. ***INTERMITTENT JET***

IF YOU KNOW even the lone guiding principle, you're far and away ahead of the average American citizen!

But in the Army Air Forces where Jet research is going on every day in the year, scientifically minded young men are getting first-hand knowledge *right where the greatest progress is being made.*

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Q. *What makes a Jet plane go?*

A. Compression of a gas to a high pressure in a confined chamber, and conversion into a high-velocity gas stream expelled into the air.

Q. *Are all Jet devices the same?*

A. No. The three types used on aircraft are the Ramjet, Turbojet and Intermittent Jet.

Q. *Can any of these drive a plane out of the earth's atmosphere?*

A. No. All three need oxygen from the air. Rockets, which carry their own oxygen, are the only known source of power for interplanetary travel. The Army Air Forces is experimenting with rockets, too.

Q. *Can any of these start from a standstill under its own power?*

A. Only the Turbojet. Its compressor acts as a starting motor, sucking air for combustion. The other types depend upon forward motion for intake of the necessary air.

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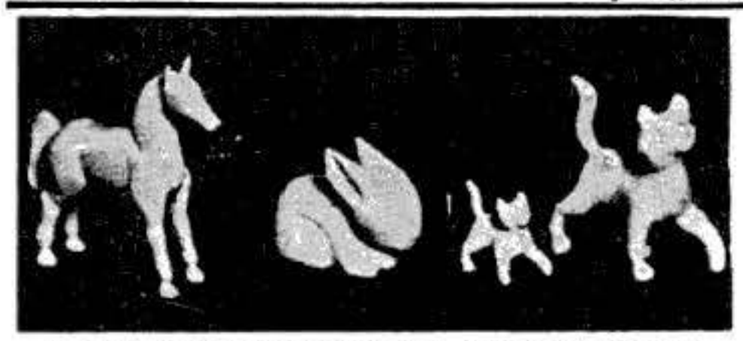
Partial List of Things to Make

Window Seats, Cupboards, Closet Fittings, Panels, Hideaways for the Family Silver, Boxes and Chests, Folding Screens, Benches, Magazine Racks, Coffee Tables, and other "furniture," Bookshelves, Trick Stuff (folding bar, secret compartment, etc.), Painting and Finishing (Oil Stain, Shellac, Brushing Lacquer, Enamel, Paint). Ideas for Desks, Dressing Tables, End Tables, Shelf Units. Plus the information of all the tools and supplies needed, how to buy lumber, information on sawing, where to build, drawing your plans, etc. **PRICE $1.50**



YOU CAN WHITTLE AND CARVE
by Hellum F. H. Gottshall

There's something challenging about a small block of clean wood that makes the fingers itch to start whittling away at it. You can really get results in turning out all kinds of amusing and artistic little pieces by following the simple directions given in this book on how and what to carve.

Once you have your sharp knife in one hand and your "blank" of wood in the other, these complete directions and full size-detail drawings guide you in making your carving perfect down to the sixteenth of an inch. Actual size photographs clearly show various stages in the process of carving. It won't be many chips later before an attractive wall plaque, a pair of dashing book ends, or a bit of personalized jewelry will seem to carve itself. **PRICE $2.25**

50 POPULAR WOOD-WORKING PROJECTS
by Joseph J. Lukowitz

With careful working drawings, perspective sketches and photographs of each article illustrating the crystal-clear directions—this book makes easy the making of 50 wood projects. Collection includes clever door stops, wall shelves and placques, a ship model, bookshelves, a toboggan, radio benches, smoking stands, sewing cabinets, etc. Every one of the articles can be made of easily obtained material and in a brief time, with hand tool processes almost exclusively. **PRICE $1.25**

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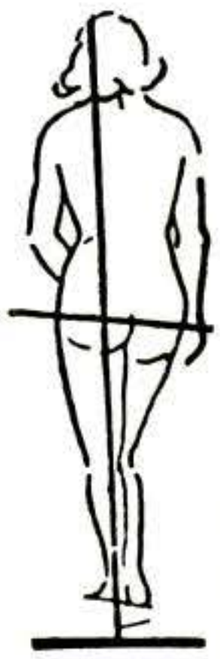

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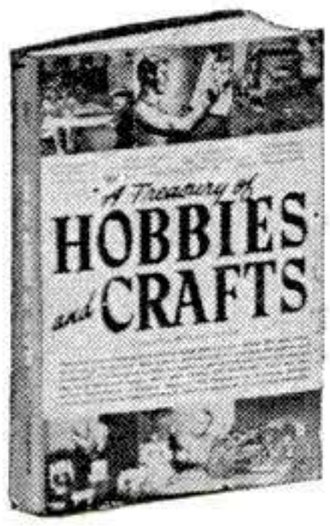

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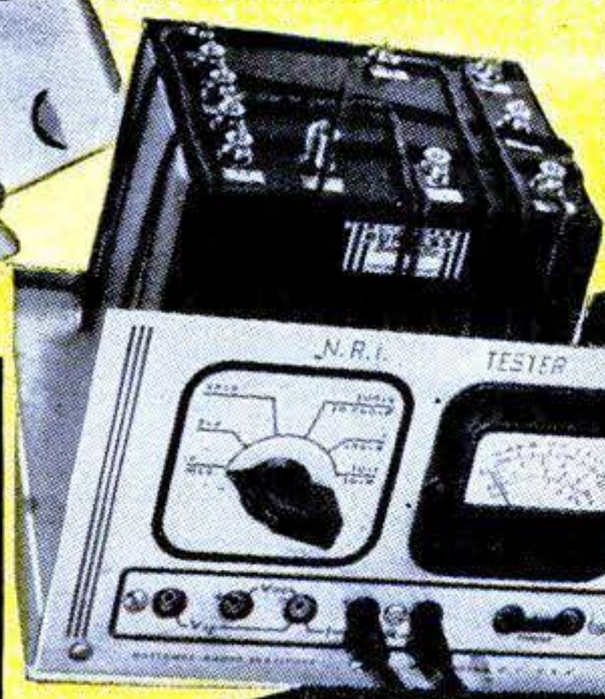

KIT 2 (left) Early in my course I show you how to build this N. R. I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.

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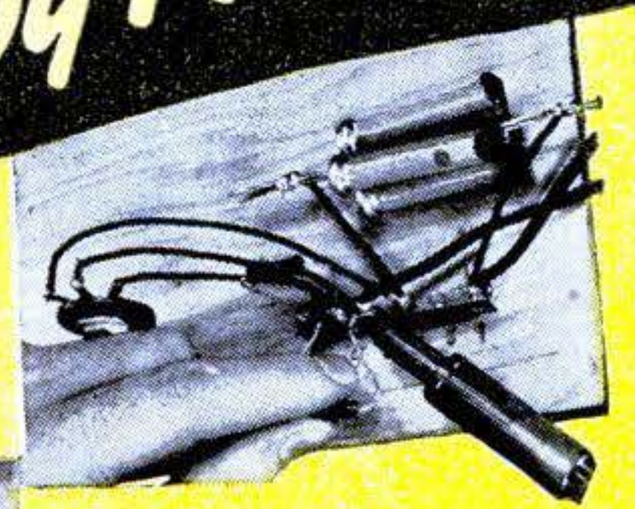
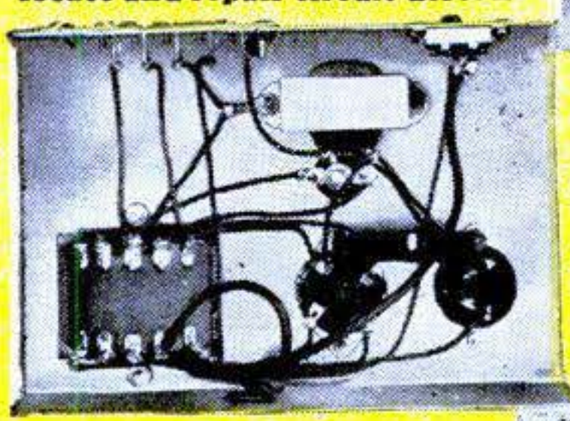
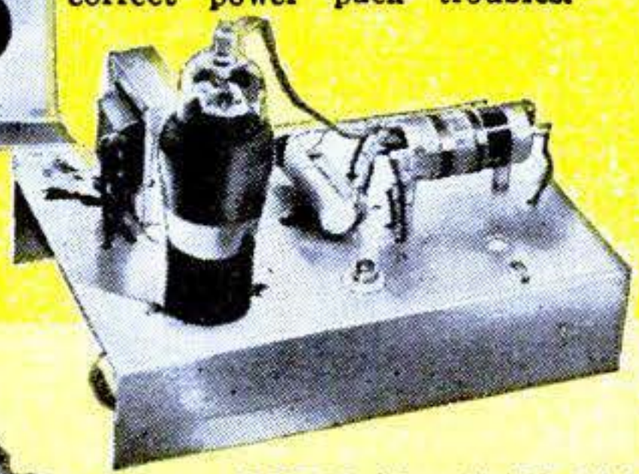


KIT 3 You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



KIT 4 You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



KIT 5 Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

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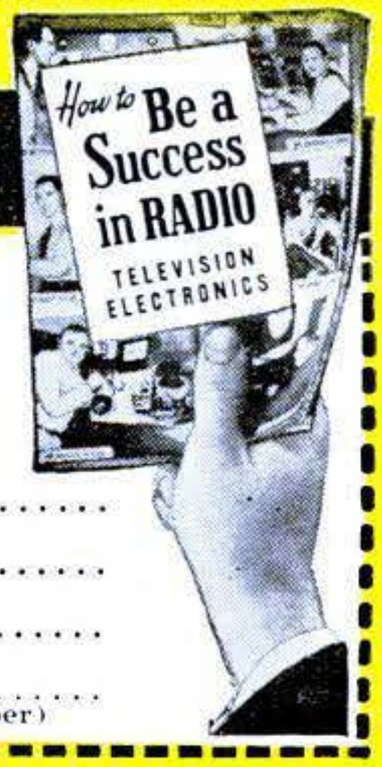

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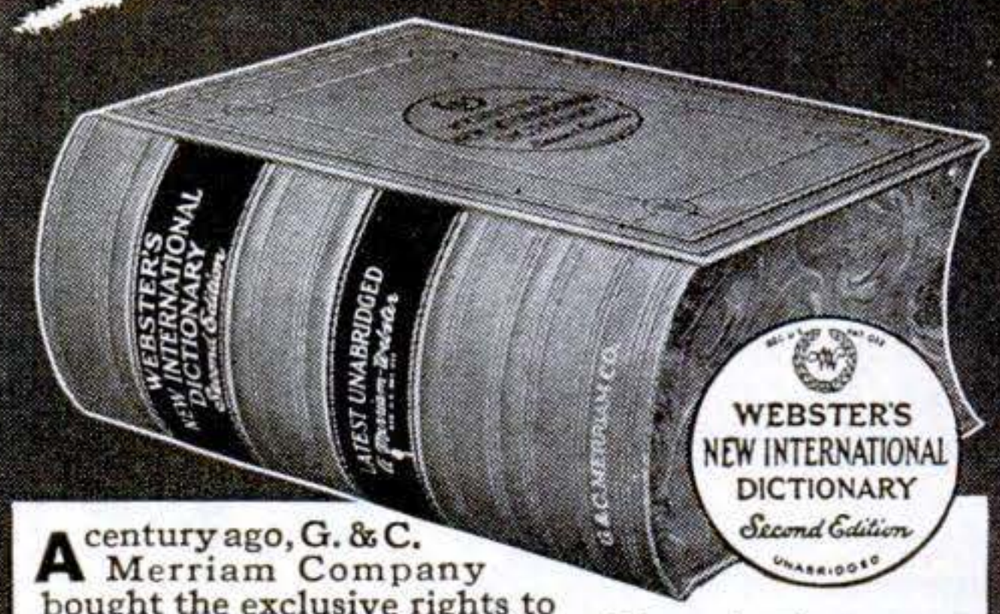

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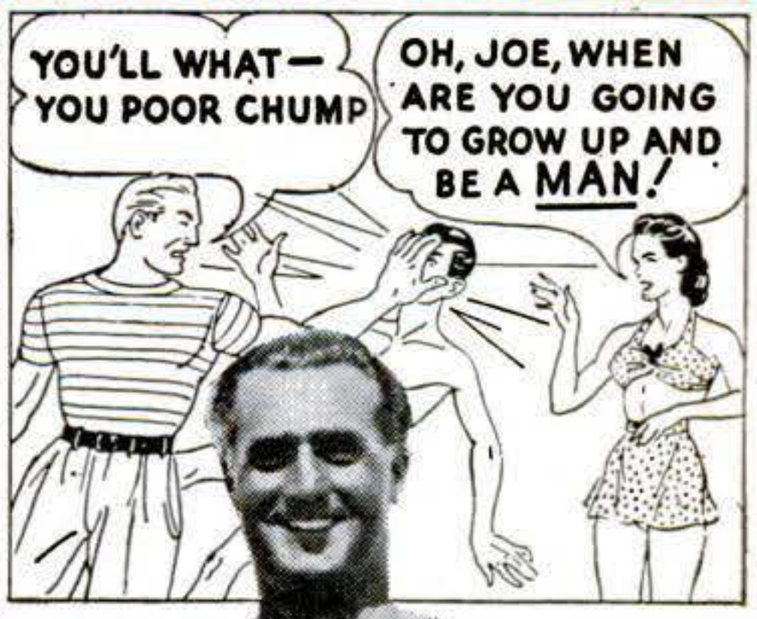

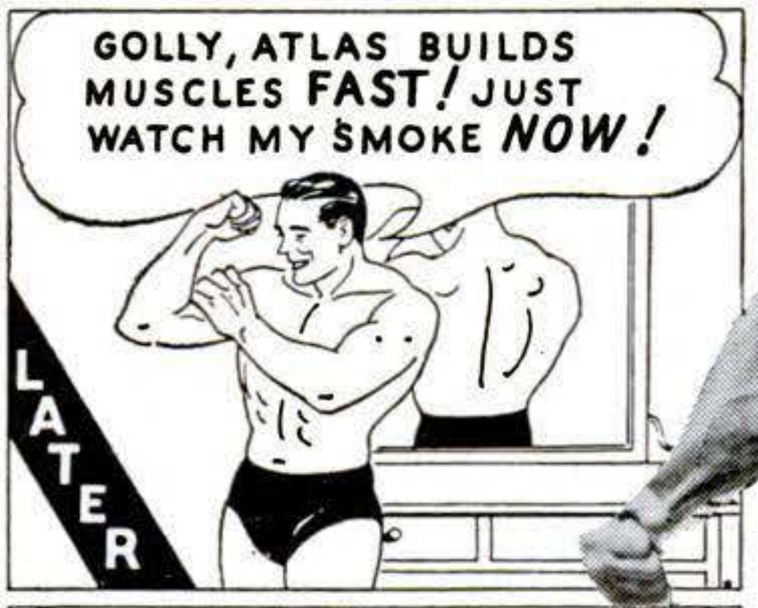

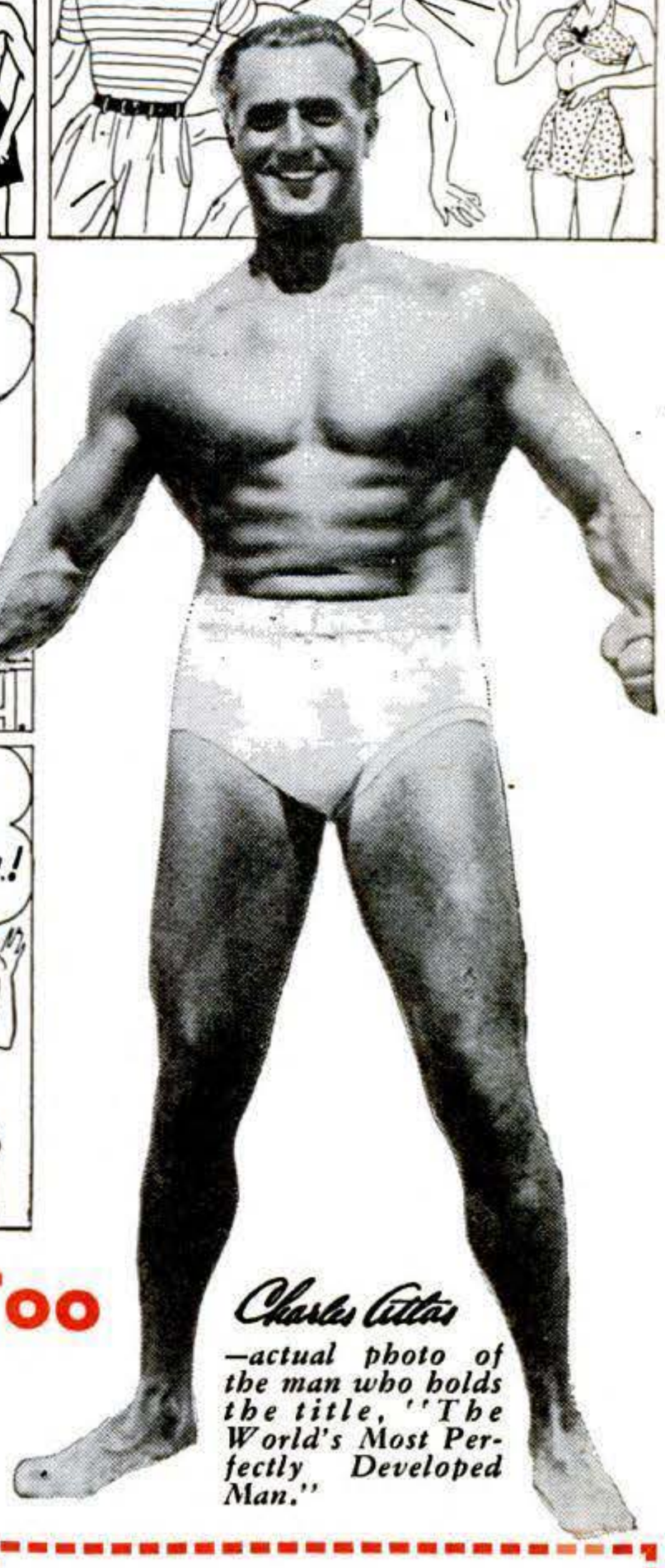

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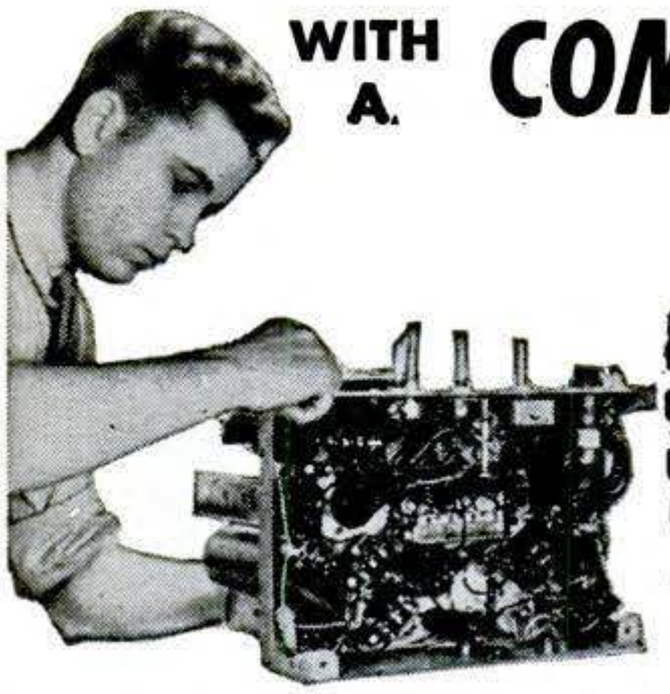

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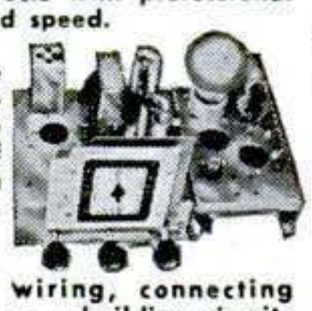

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LETTERS

The Science of Good Will

Sir:

Your editorial in the December issue does not come as a surprise to anyone who follows the good reporting of *Popular Science Monthly*. If the scientists of the United States believe that a study of the "science of creating good will" should be undertaken at this time, they will learn without doubt that the public is ready to assume the extra expense entailed by collective and separate investigations. . . .

GEORGE BATCHELDER

Woodsville, N. H.

They Even Sell 'Em

Sir:

I am writing this on the day I sold a small house trailer built from the plans in Popular Science of March and April 1946. I have been working on the trailer since June 1 and have had a lot of pleasure building it. The cost was very reasonable and I sold it for a nice profit. . . .

H. L. ANDERSON

Ludlow, Ky.

The Camera Didn't Lie

Sir:

The more I look at the pictures of the wood "seating bucks" of the 1947 Ford in your November issue, the more confused I get. I've studied the picture of the rear seats enough to know that it is not the angle. On the right side you will see that the rear seat does not come up to the opening of the door, yet on the left side the seat comes up halfway on the door—or at least it looks like a door. . . . All I can figure out is that it may be a "three door." . . .

DON KELLEY

Oakland, Calif.

PSM quotes from the Ford Company's reply to Reader Kelley: "Your conclusion is accurate. The seating buck is equipped with

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INVENTORS

Patent Laws Encourage The Development Of Inventions

The Rules of Practice of the U. S. Patent Office advises—unless an inventor is familiar with such matters—that he employ a competent registered attorney, as the value of patents depends largely upon the skillful preparation of the specifications and claims.

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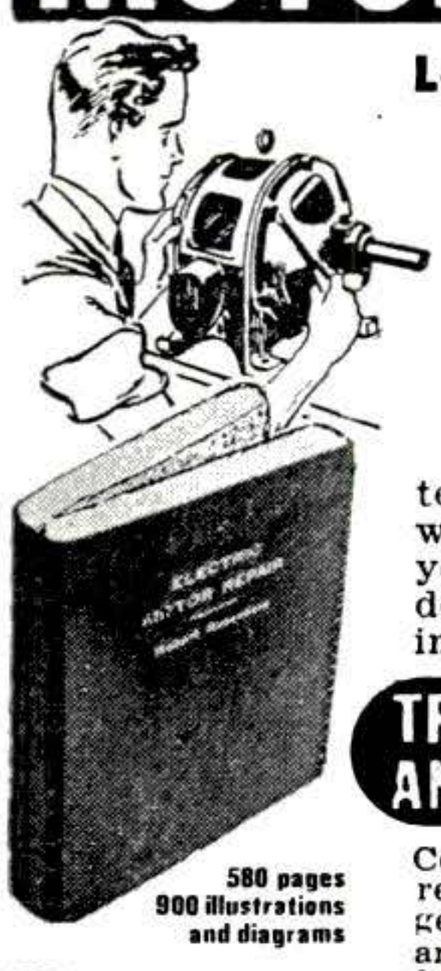

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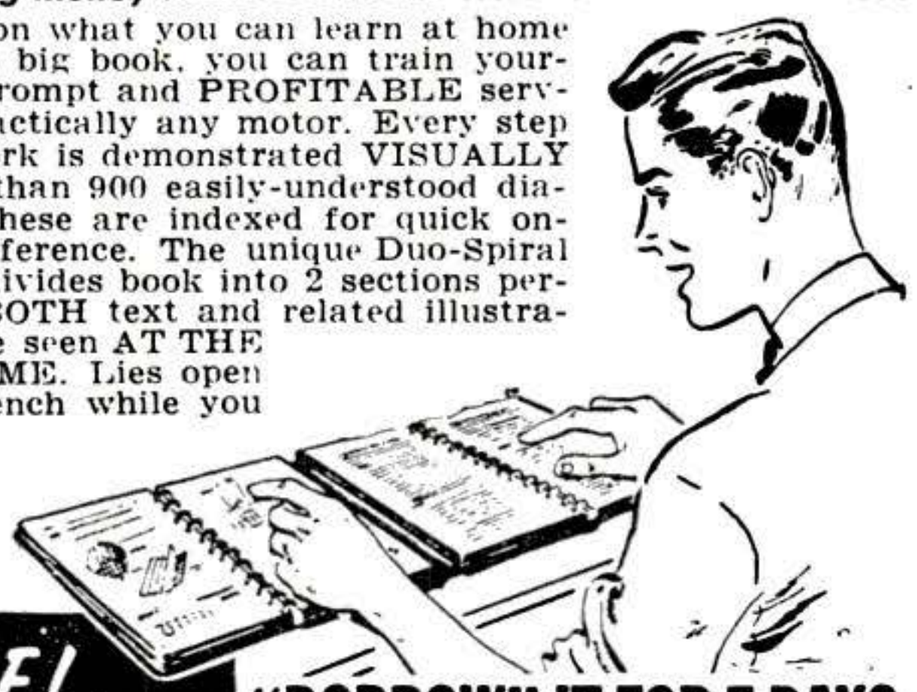

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"One Man's Meat . . ."

Sir:

Your magazine has been very valuable to me in giving leads and advance ideas. Recently someone gave it a trend to the morbidity of *Esquire* and *National Geographic*, so that it is a scientific treatise rather than an idea center. . . . Much of your material lately is for the specialized home workshop and not for the farm-boy improviser. . . . Let us help him with that improvisation and creative thinking. He can get science articles at the library.

GERALD MCCLURE

Akron, Ohio

Sir:

I have been taking your magazine for seven years. . . . When the war began the magazine began to get worse, but I was willing to take it. When the war ended, I looked for a better Popular Science and thought I was getting it. Soon I could see that I was doomed to disappointment. It has now gotten so bad that I feel you need to change the name (to) Popular Handicraft or Unpopular Tripe. . . .

JOHN KAUFMAN

Grinnell, Iowa

Sir:

It is with a great deal of personal pleasure that I am renewing my subscription to your magazine for the sixth year. Never has one item such as PSM been so valuable. I have put the reams of information gleaned from it to such extensive use around the house that whenever anything goes wrong I am asked, "What does Popular Science say about this?" . . .

RONALD MALT

University City, Mo.

Sir:

All the articles in PSM are good, although some of them I personally am not interested in. However, you can't please all persons, and there is enough of everything to satisfy everybody. . . .

HAROLD HIRST

Minneapolis, Minn.

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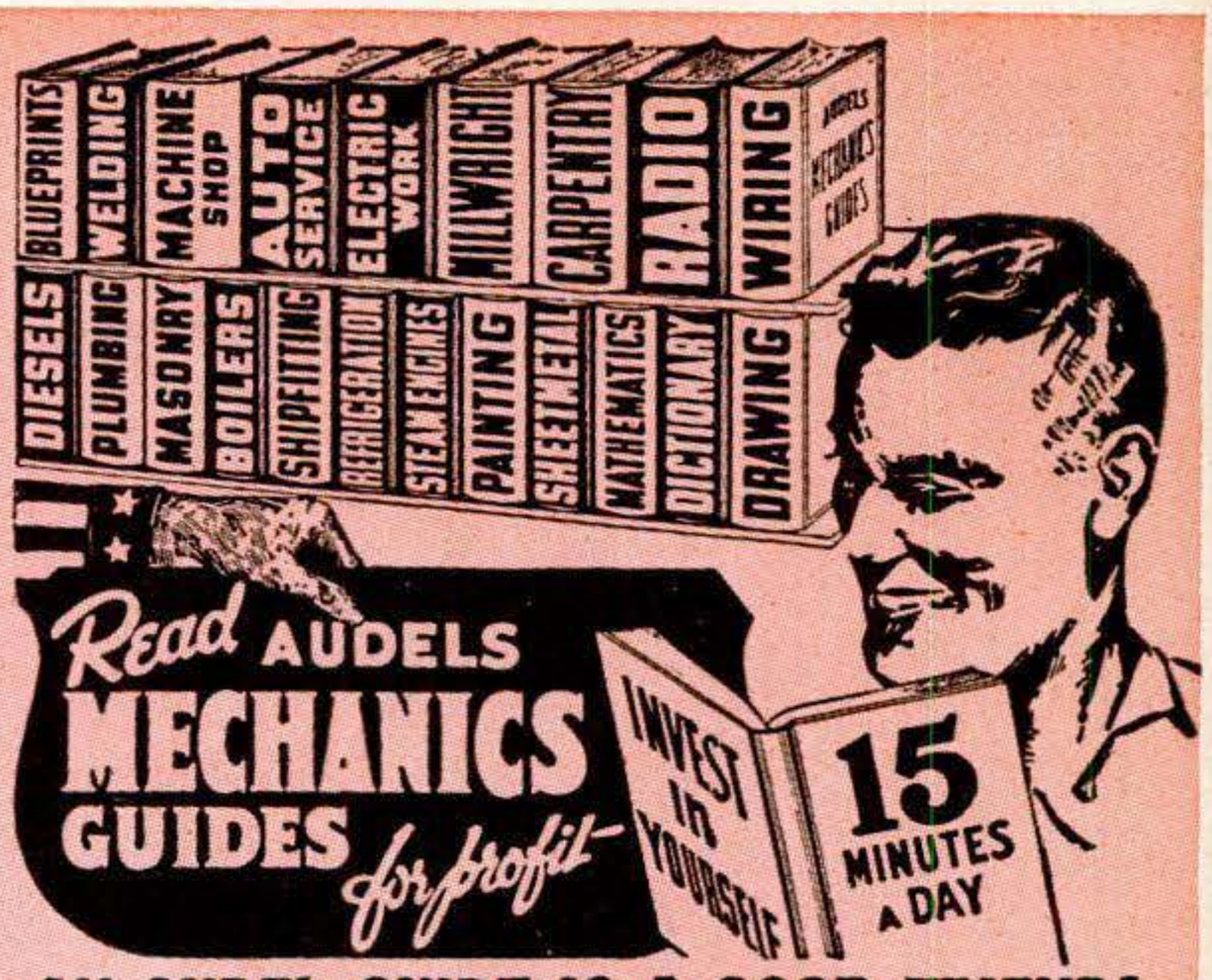

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Sir:

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PETER METZGER

Anaheim, Calif.

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CARL FRIZ

Elmhurst, Ill.

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The Common Ground

Sir:

I want to commend you on your page on "What Do a Physicist and a Mechanic Have in Common?" (PSM, Dec. '46, p. 294). Too many schools and colleges do not realize the inseparability of knowing what to do and how to do it.

Here at the Hanford Nucleonics Plant you have many enthusiastic readers—many physicists, many mechanics. It used to be, when most of us came here, that we stuck to our job. Physicists read *"Physical Review," "Journal of Applied Physics"* and other such books of the trade. . . . Our mechanics read Popular Science and told us so many new things that now a large number of our best men read it. . . . The mechanics, strangely enough, have taken to reading the denser stuff. . . . Both parties profit. . . .

I am in the Research and Development group, and every month I tear up my PSM the day I get it and hang on the bulletin board the ideas to be investigated. December issue: 18 ideas. . . .

JOHN HOLEMAN

Richland, Wash.

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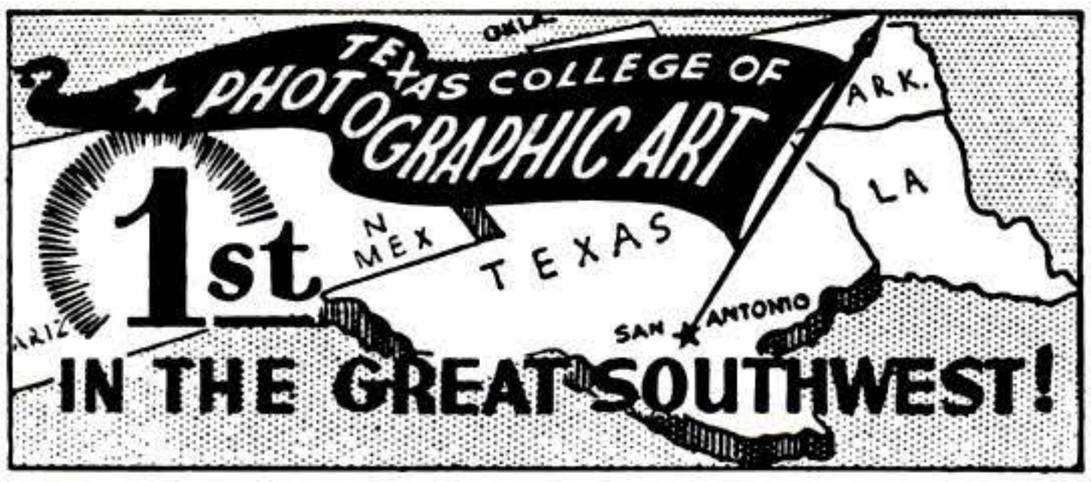

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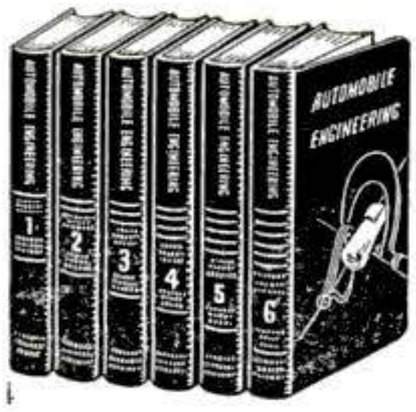

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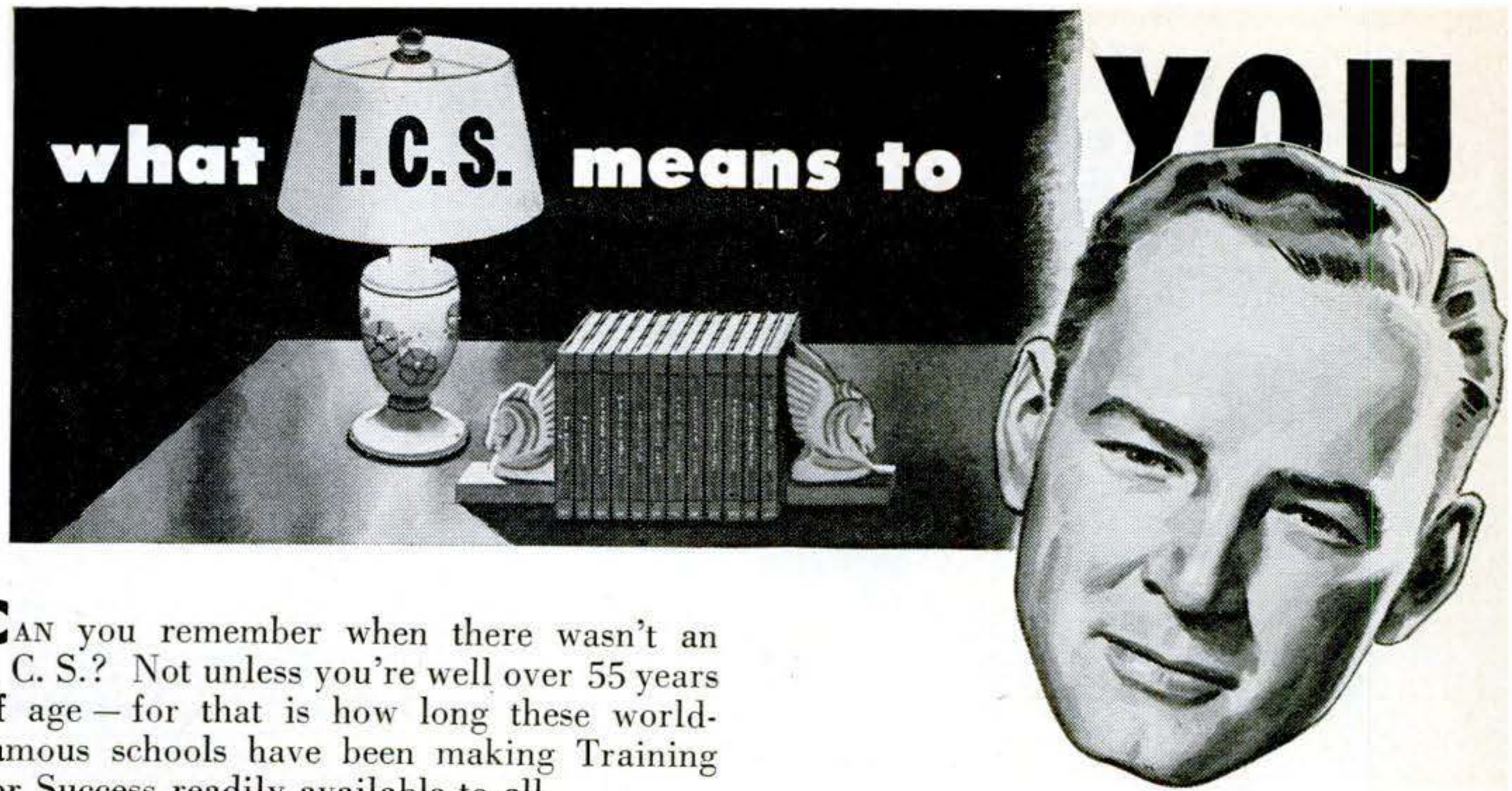

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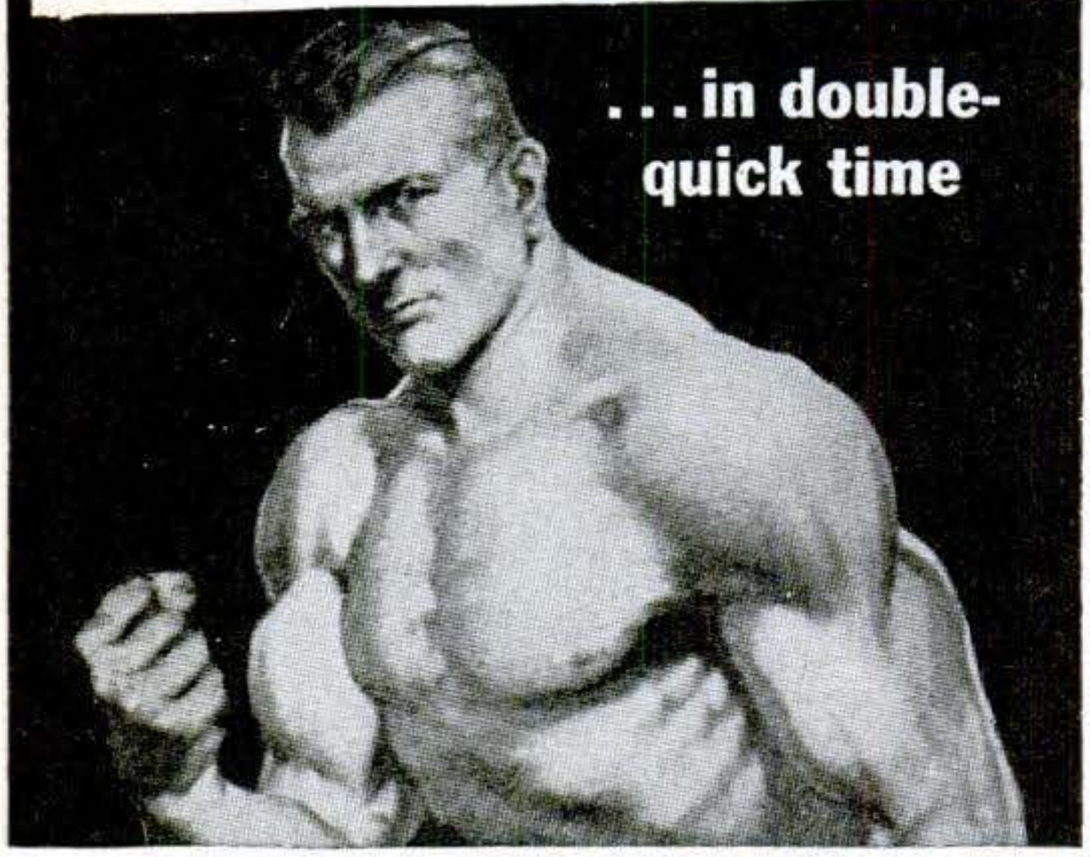

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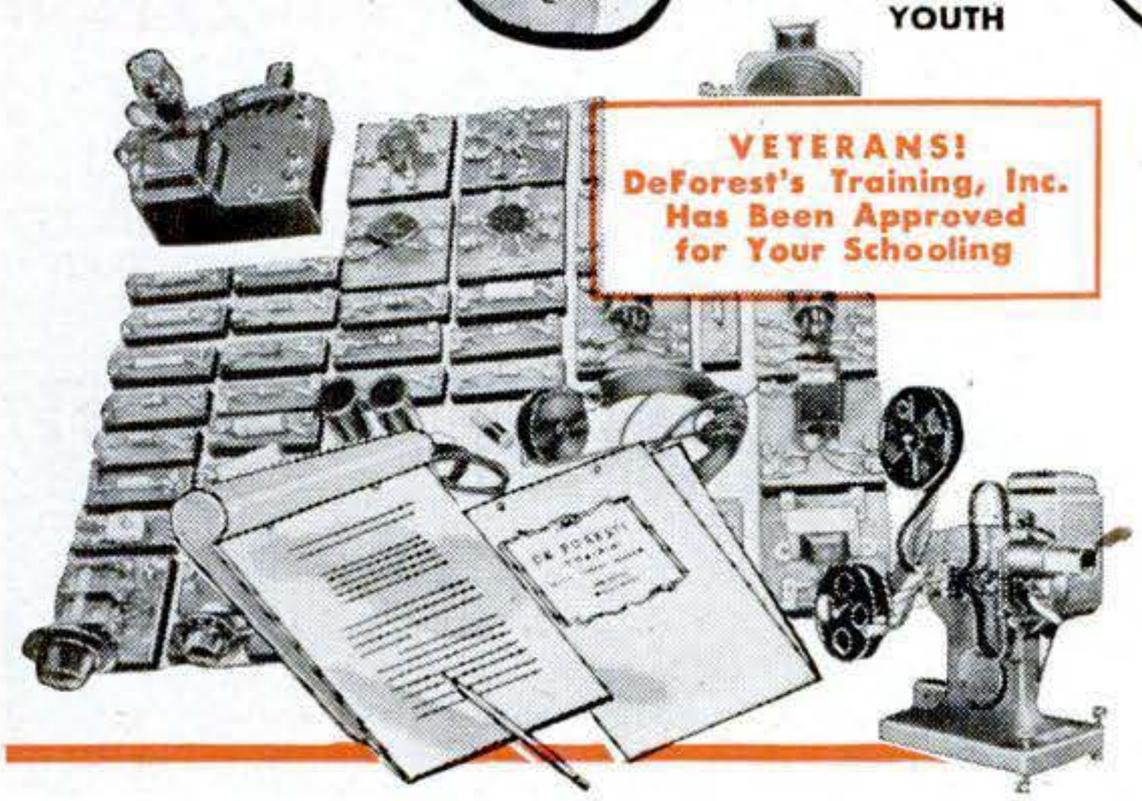

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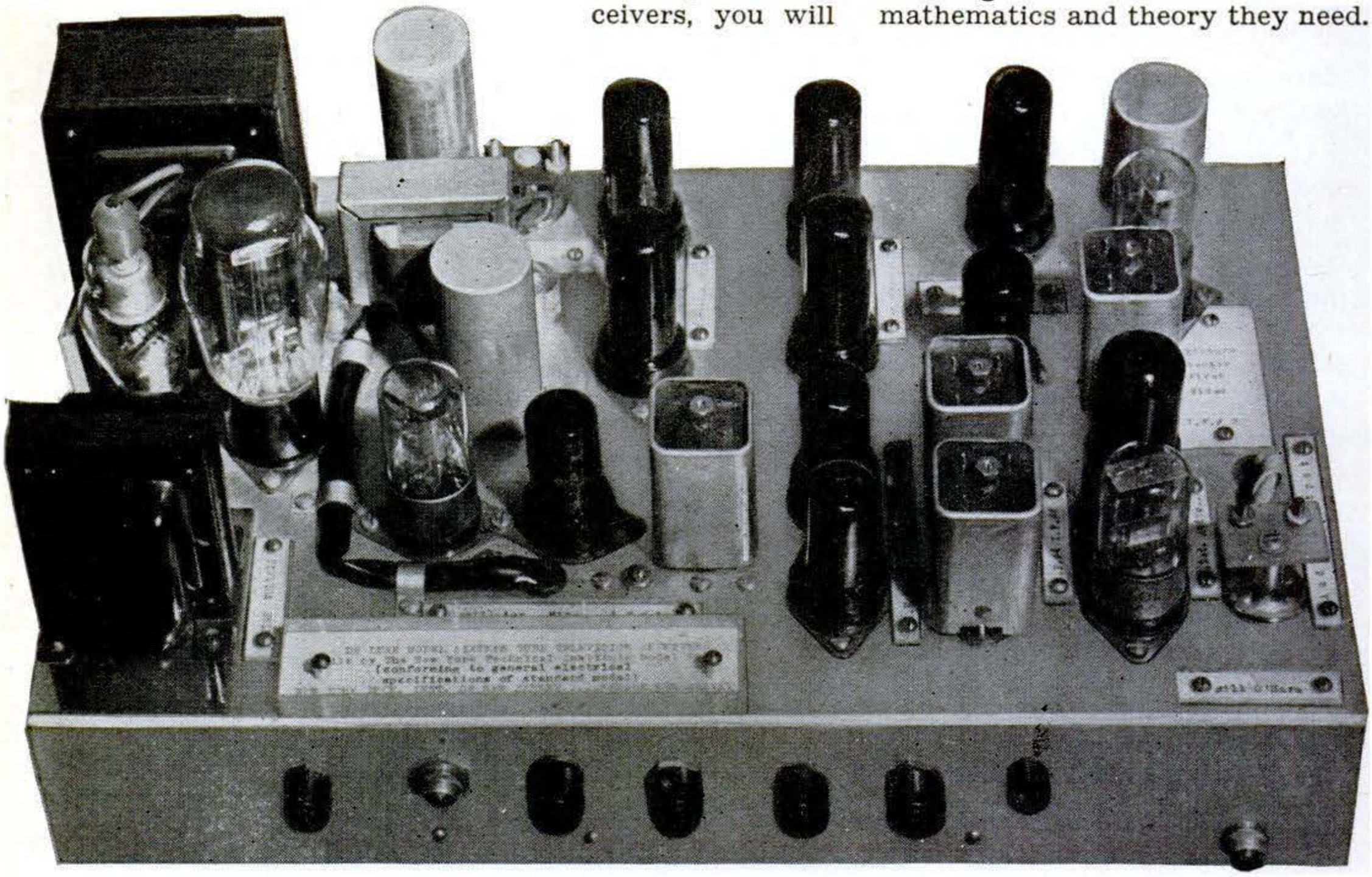

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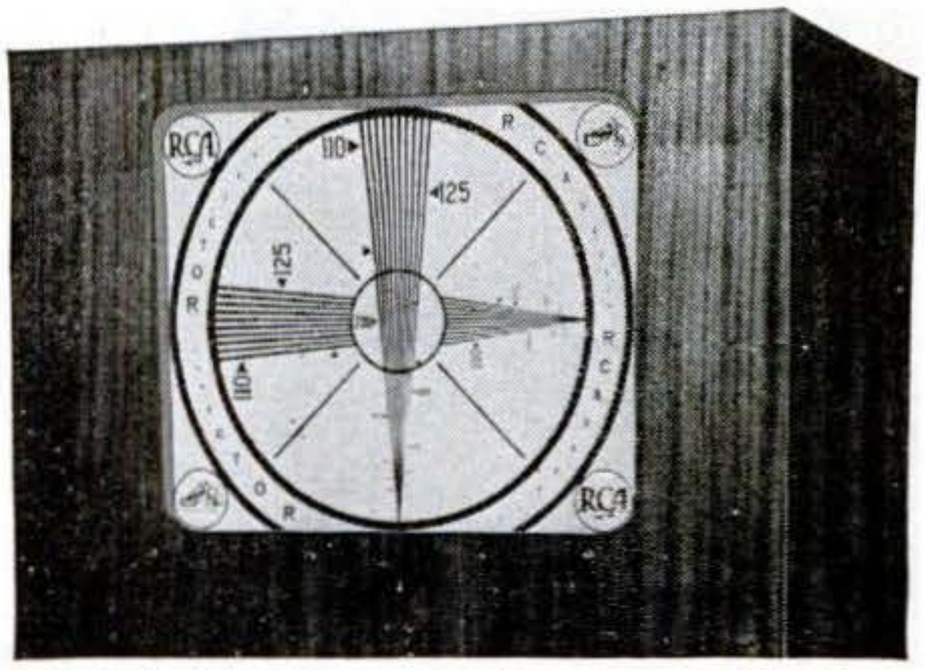

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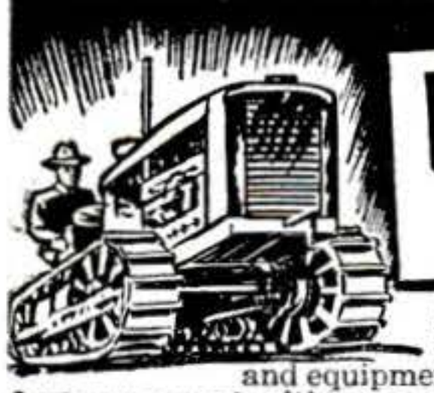

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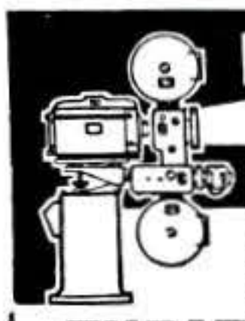

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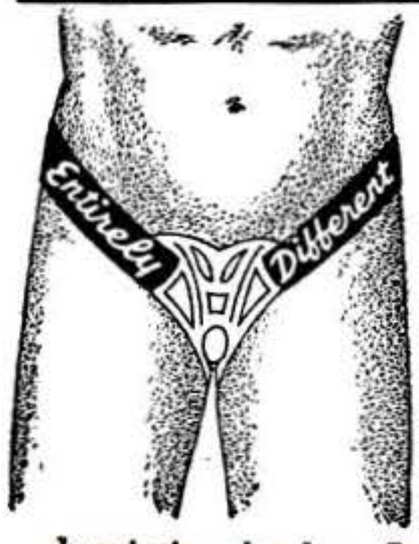

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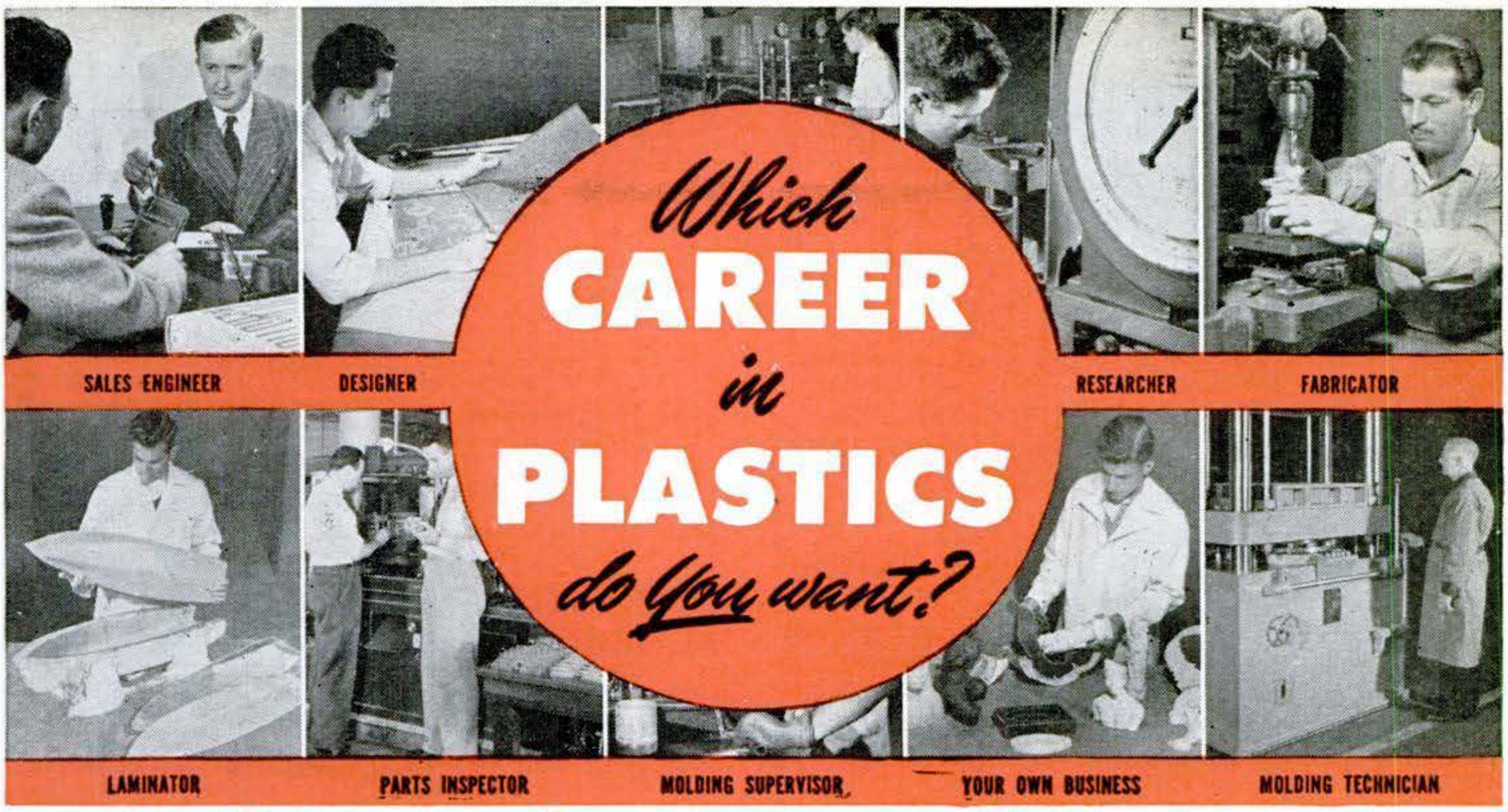

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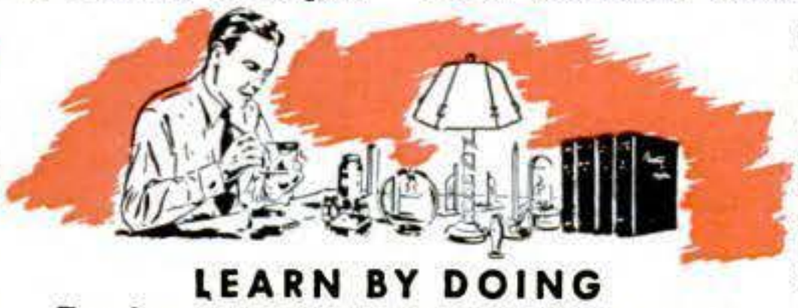

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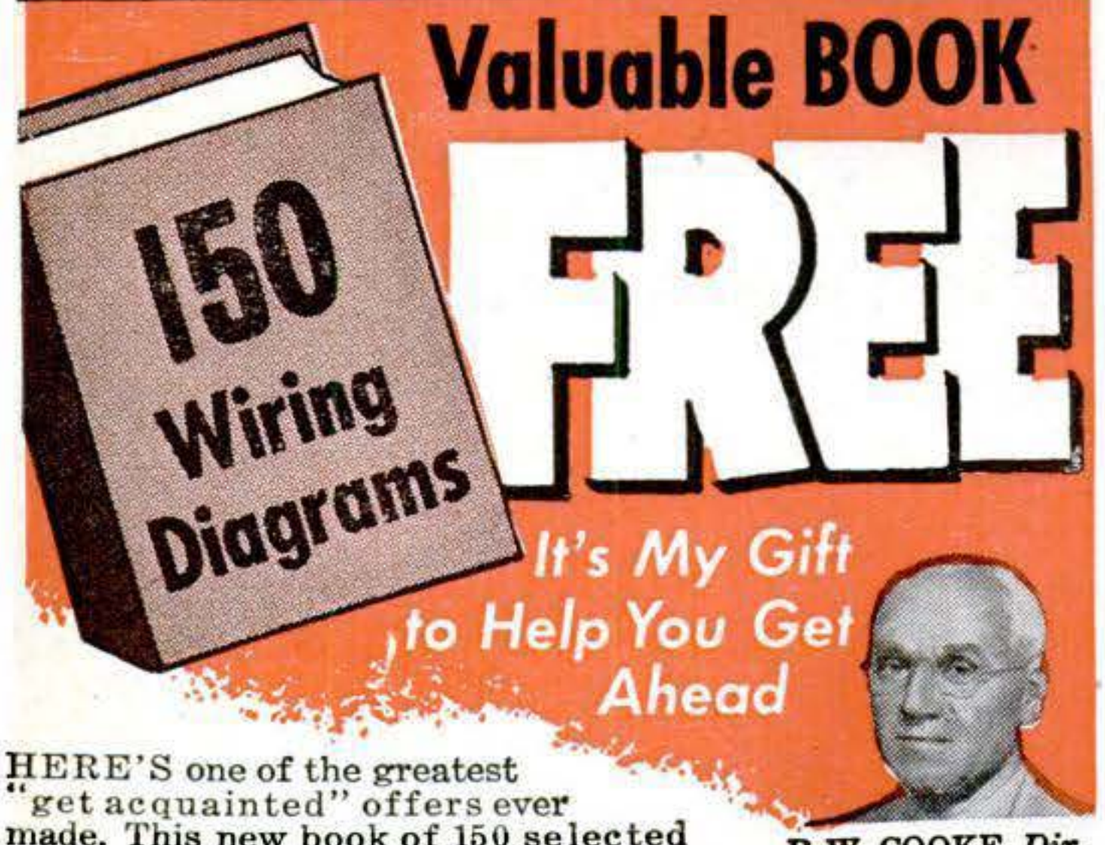

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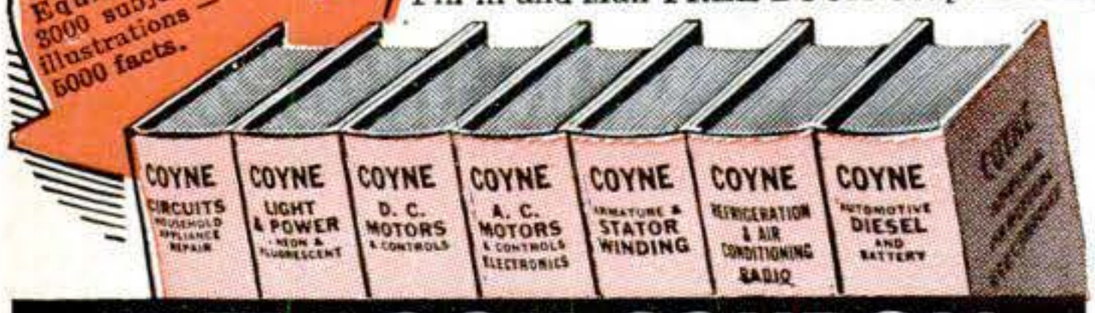

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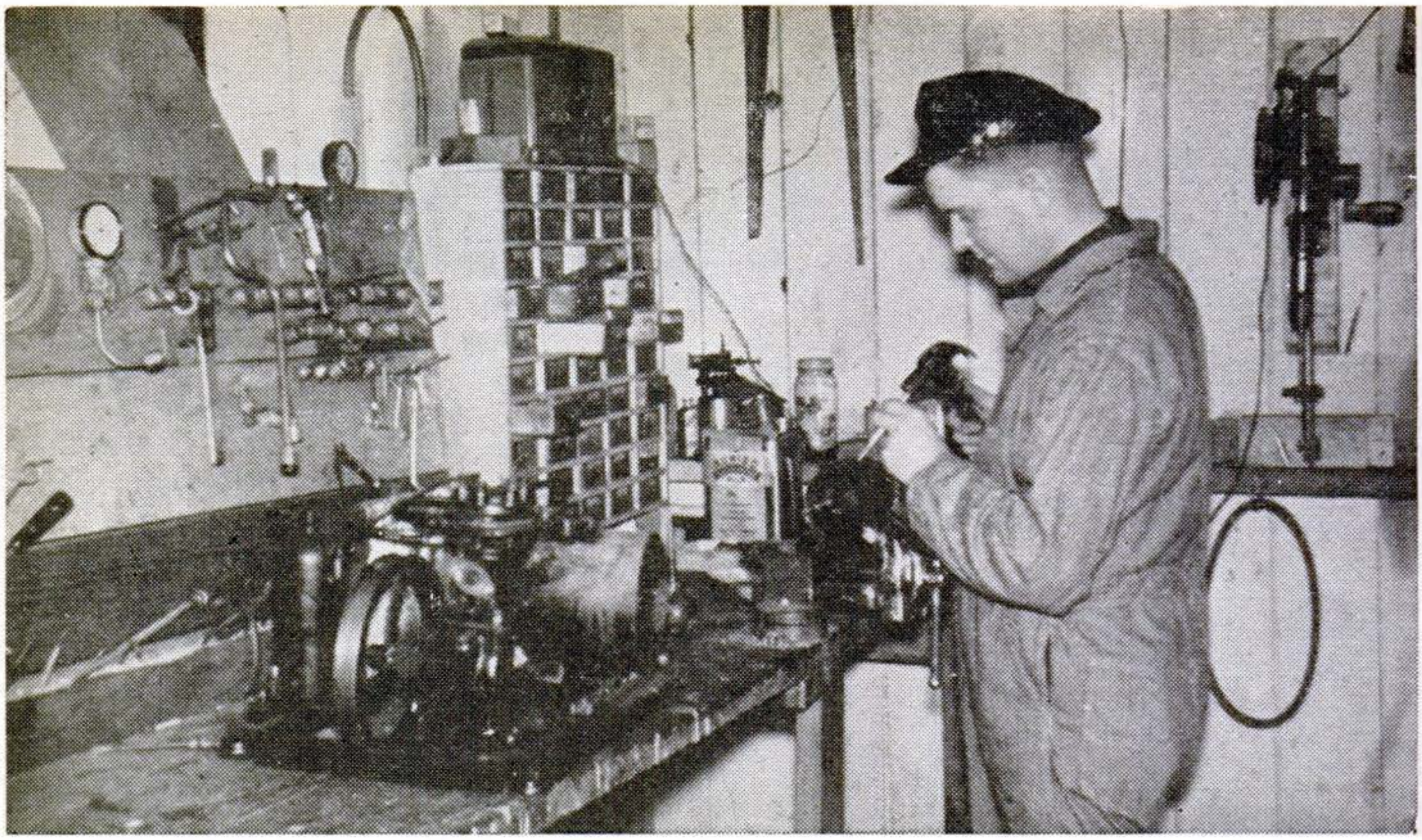

SO IT NEEDS FIXING

By S. T. CHRISTENSEN

the "Fix-it-Man"

"WELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

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At first, I let the owner decide the charge and, frankly, I was amazed at what I earned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some jobs) were a little difficult to get. But that situation quickly adjusted itself and many repair parts were given the high priority rating of AA2. After all, we had to provide for the health and well-being of our civilian population.

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To the contrary, I've prepared a complete course, chuck full of simple, easy to understand photos and drawings and written in the same non-technical language as this article. I know the course is good, because I have hundreds of men all over the country writing to me telling me how the course has helped swell their pockets with cash. If you too want to prepare now for your future, I suggest you read the next page and send me the handy coupon."

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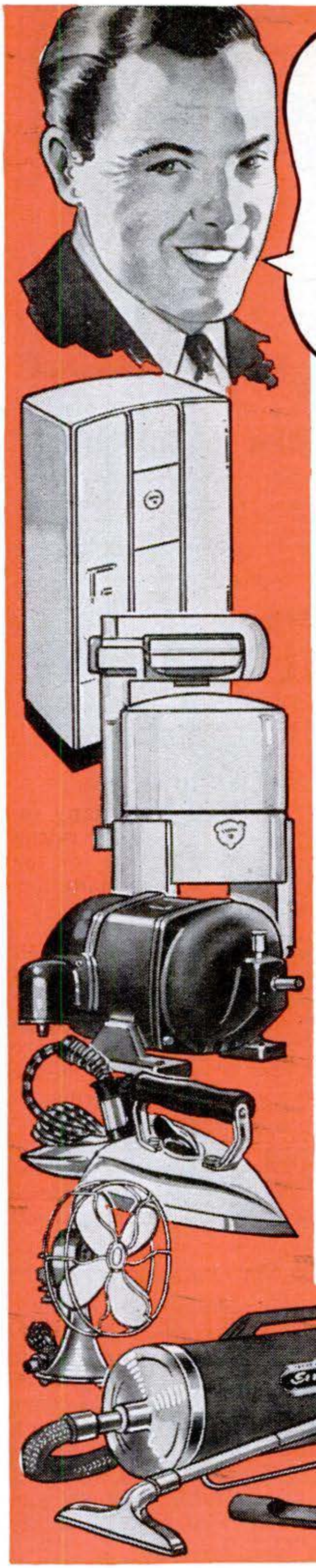

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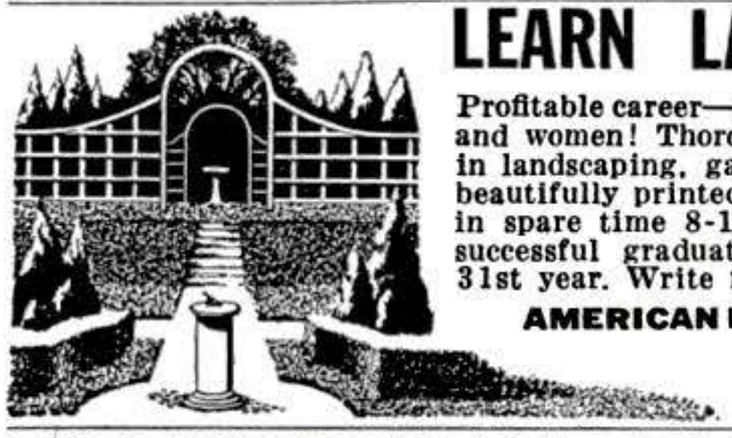

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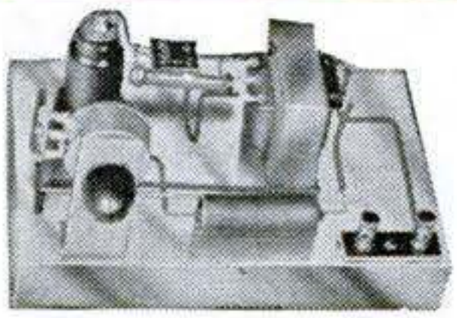

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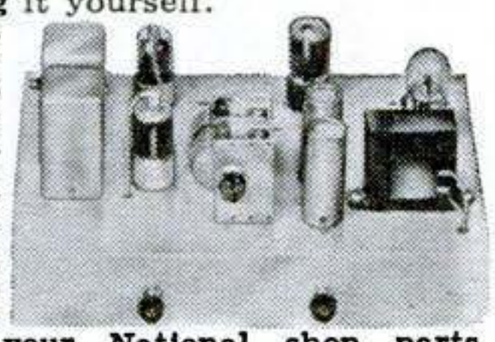

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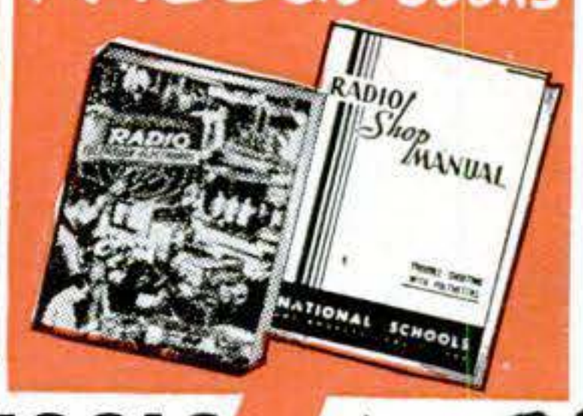

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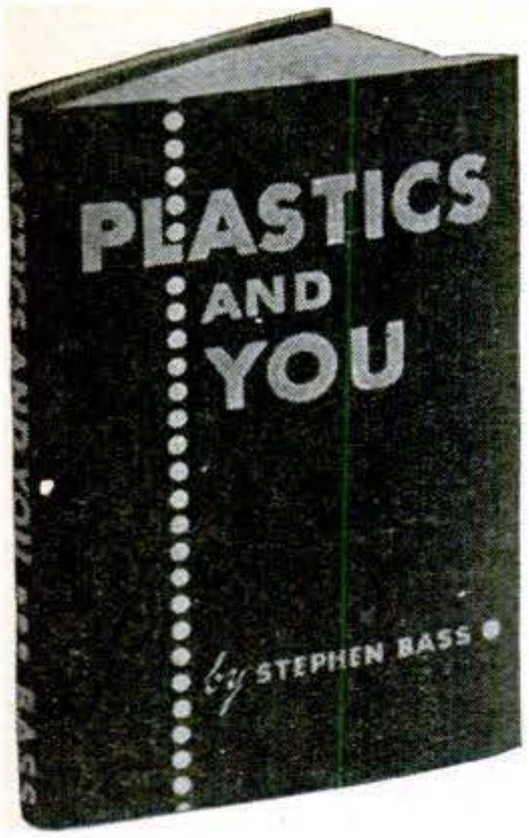

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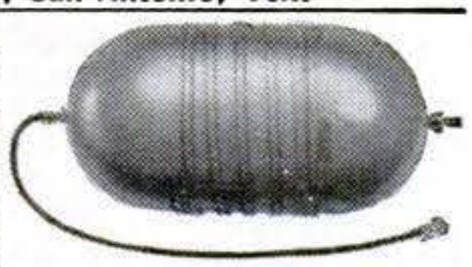

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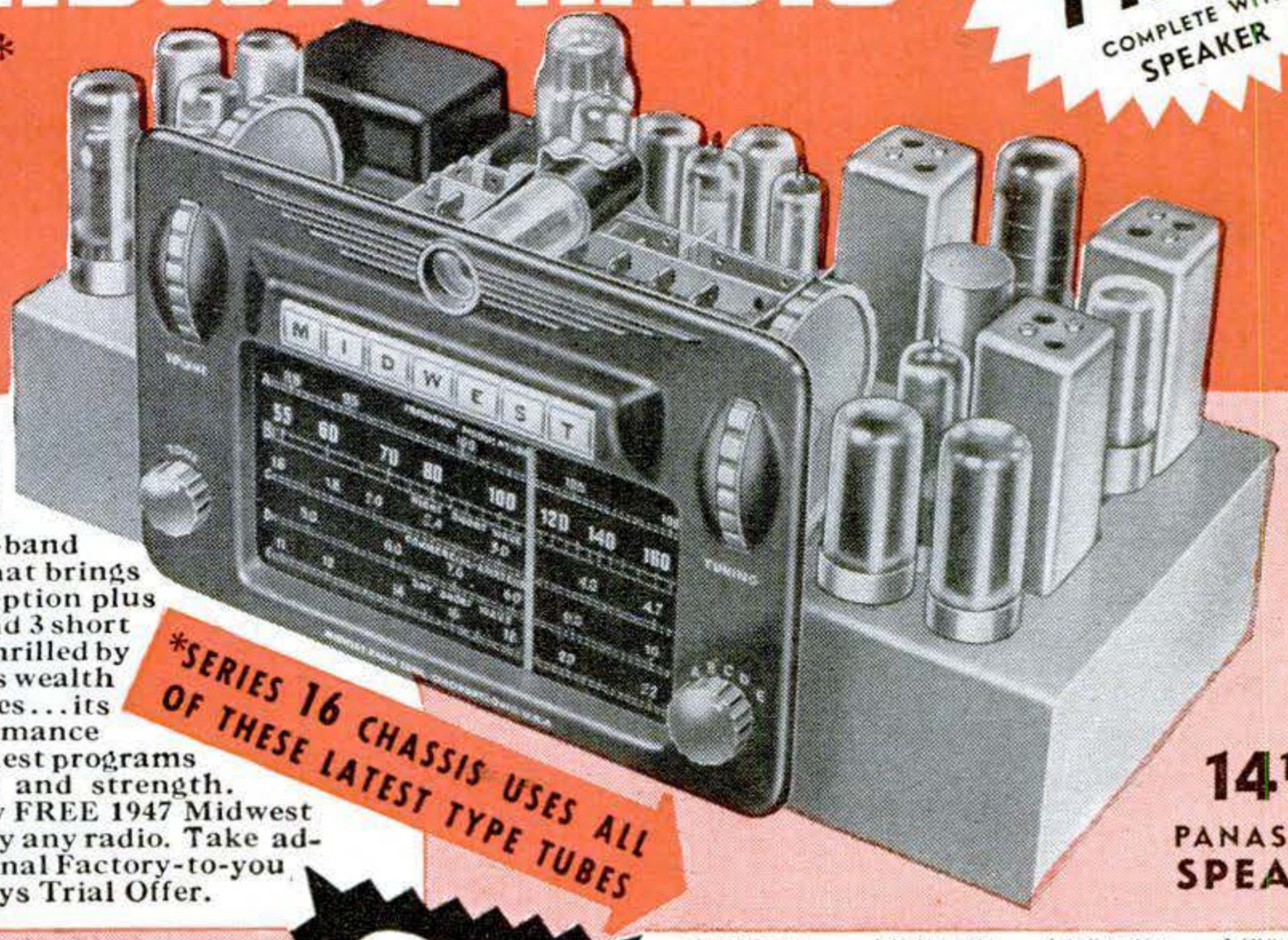

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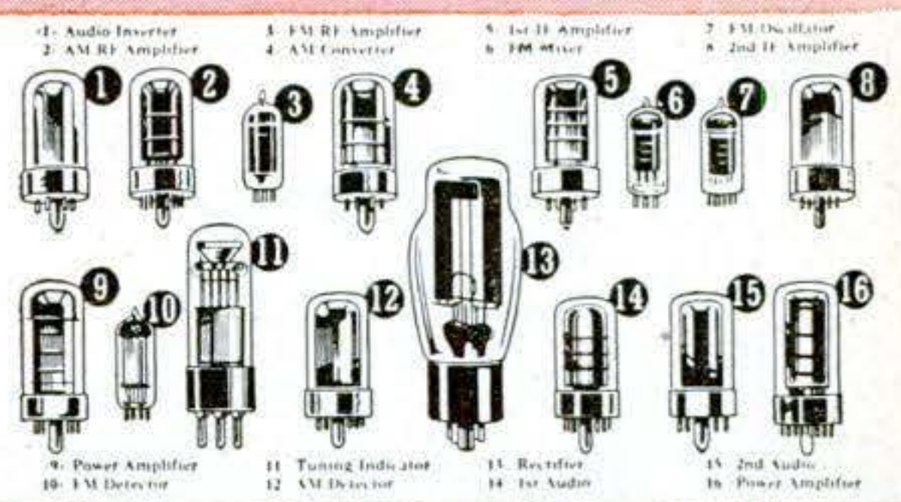

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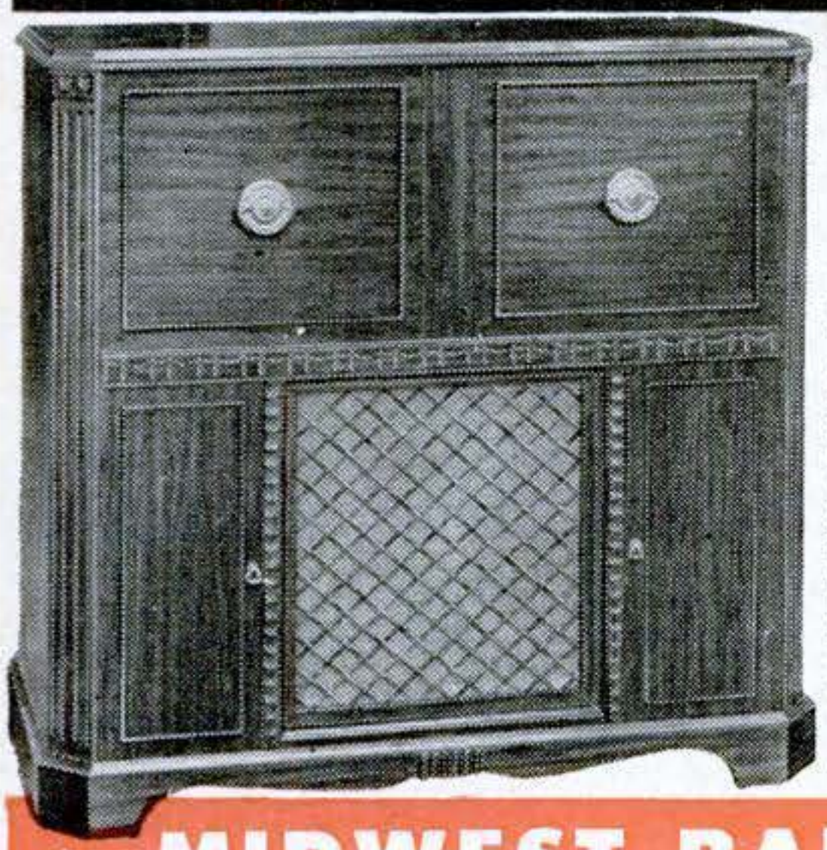

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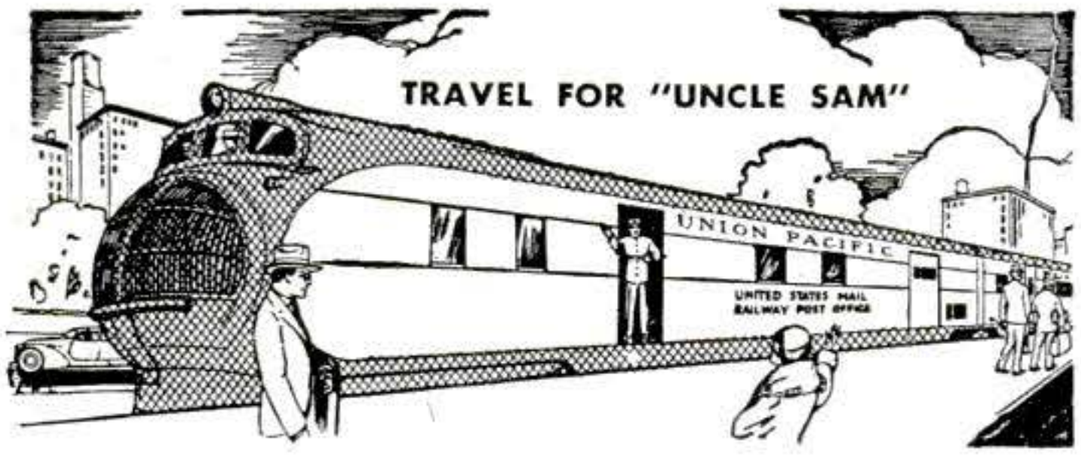

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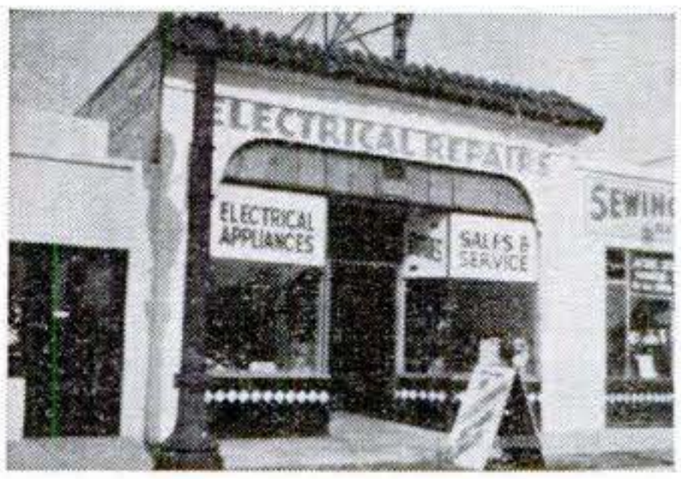

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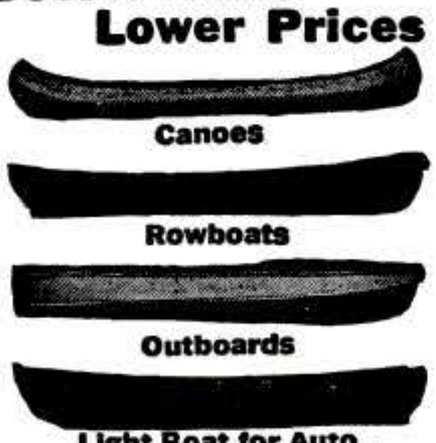

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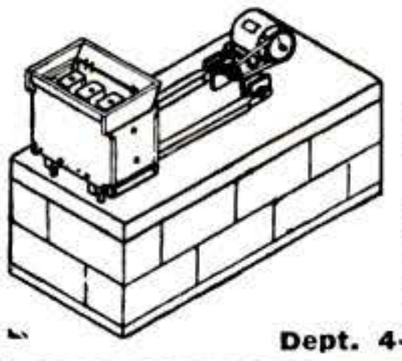

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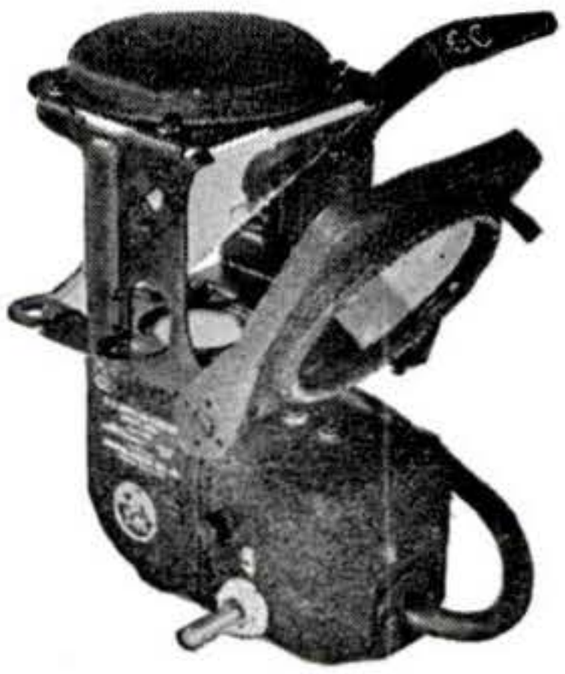

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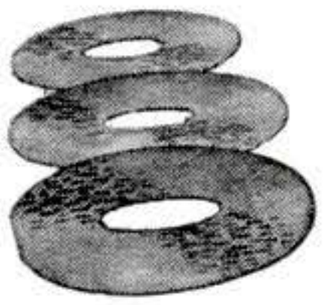

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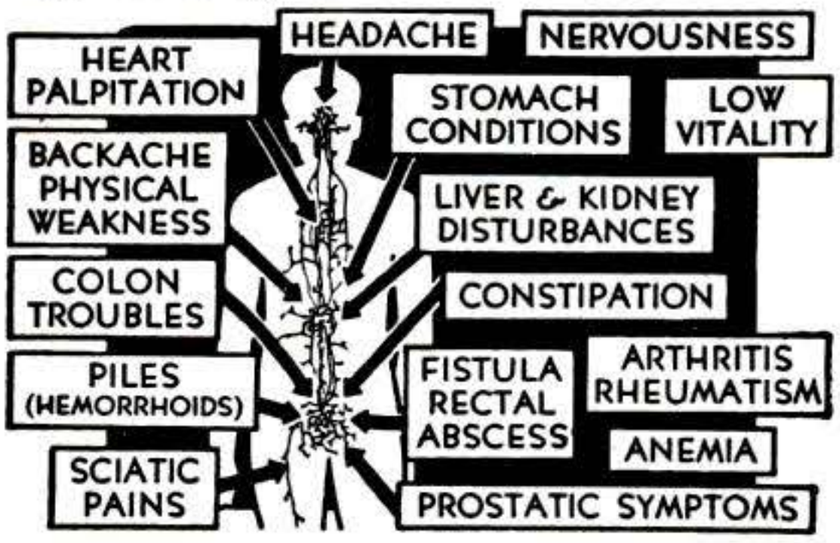

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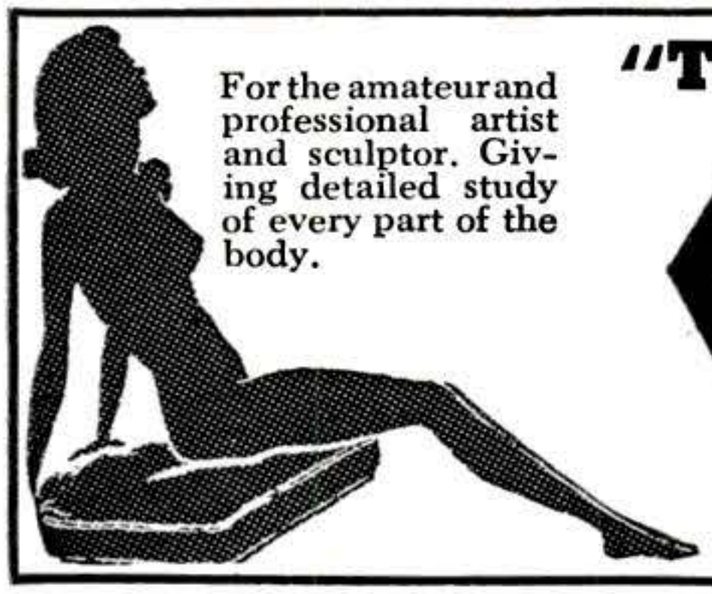

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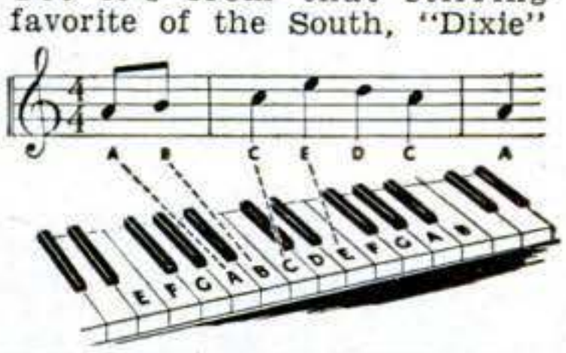

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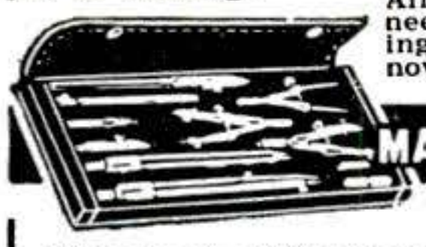

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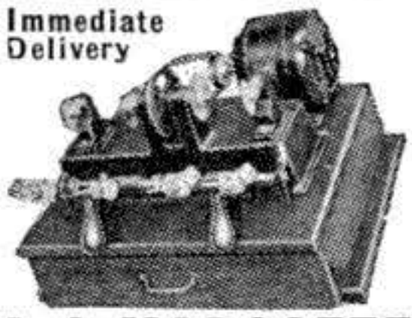

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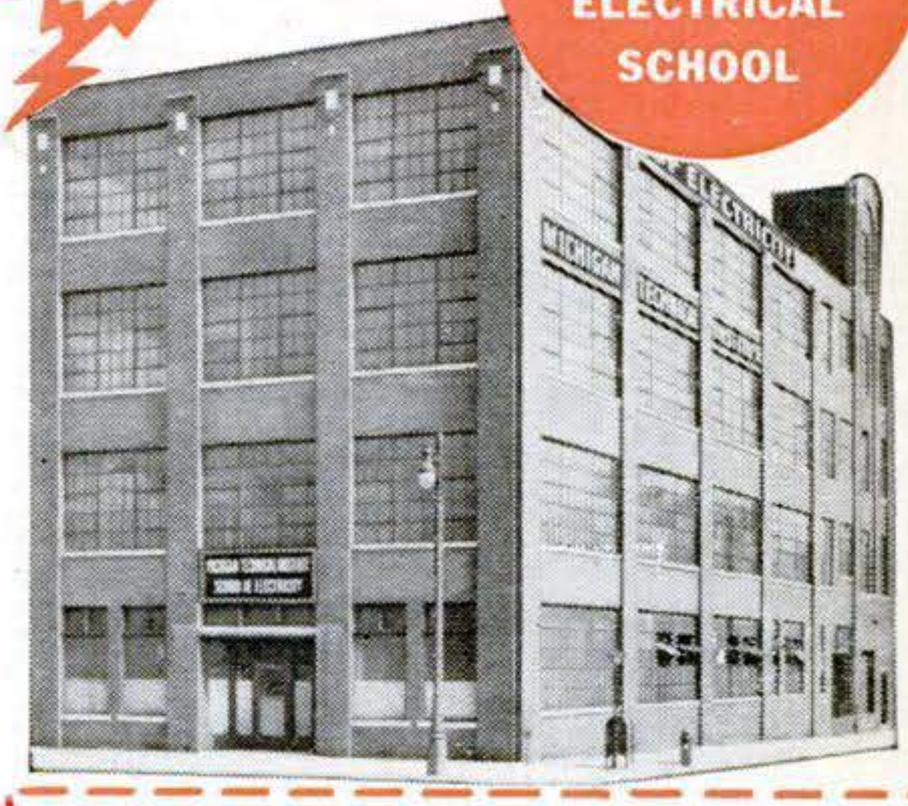

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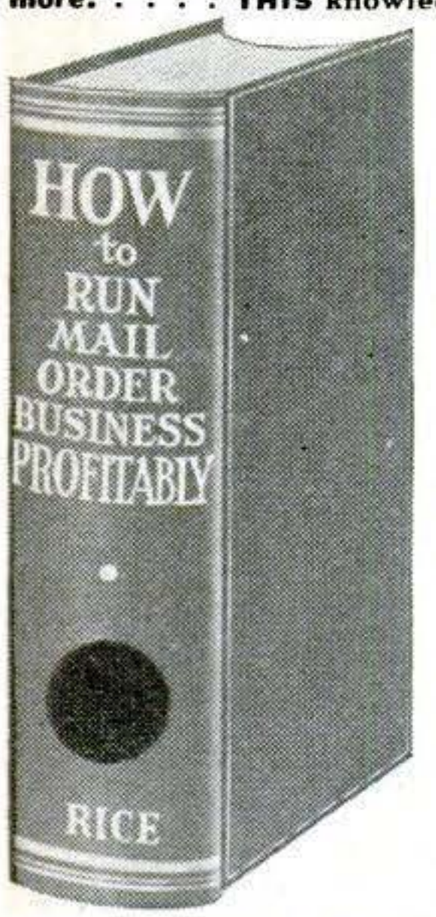

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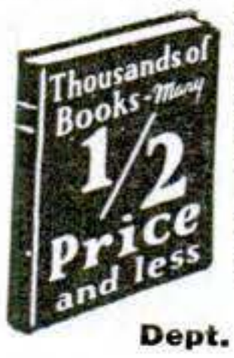

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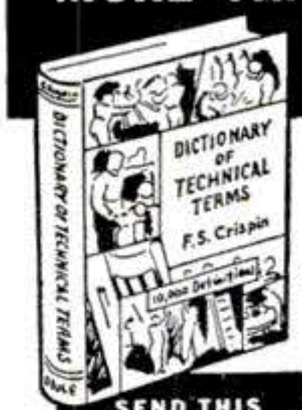

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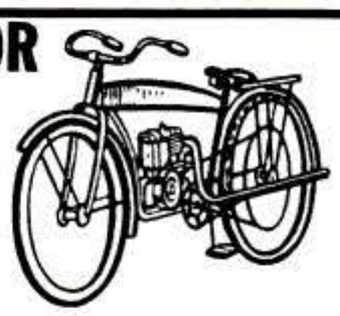

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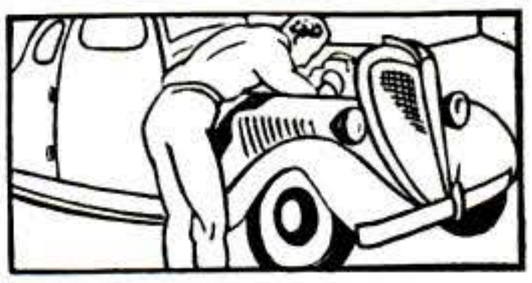

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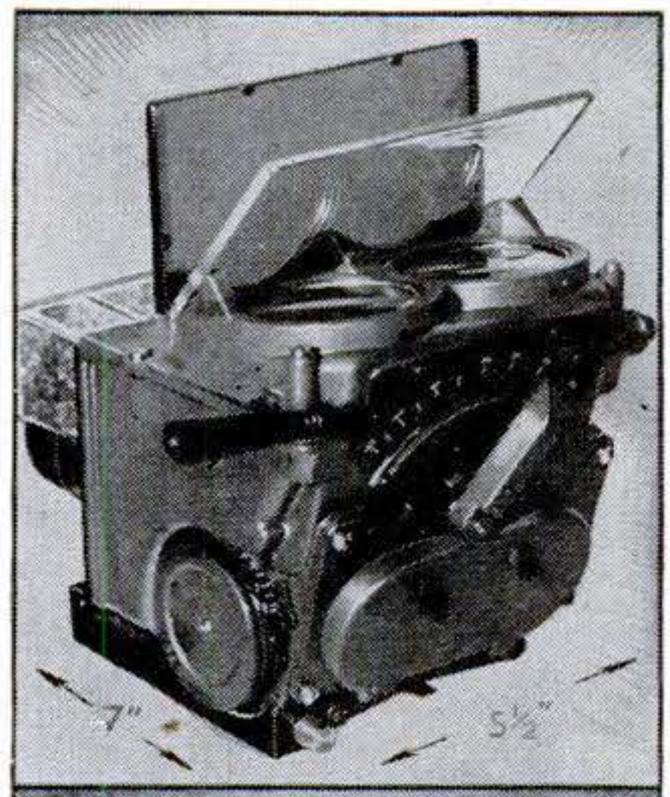

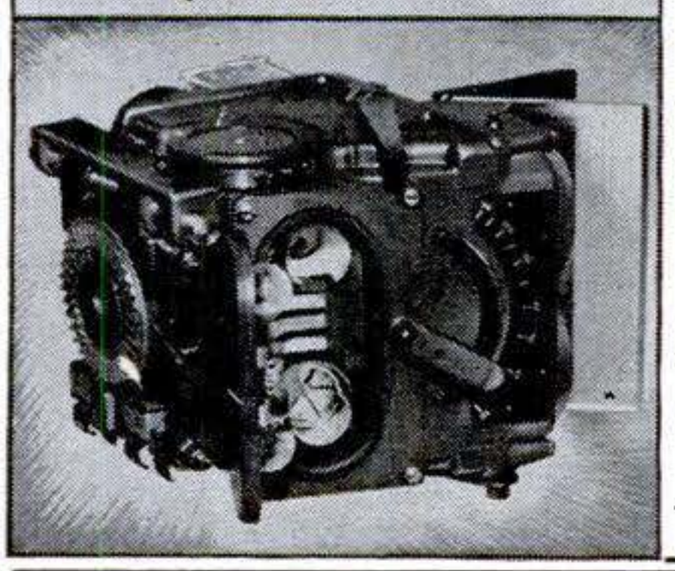

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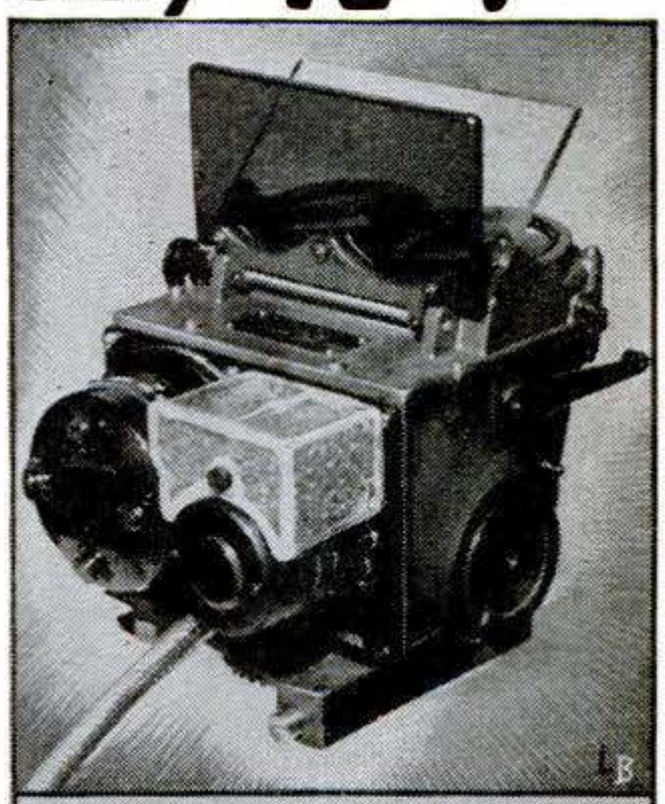

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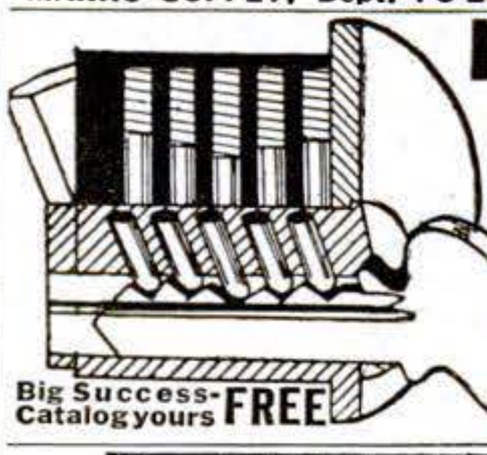

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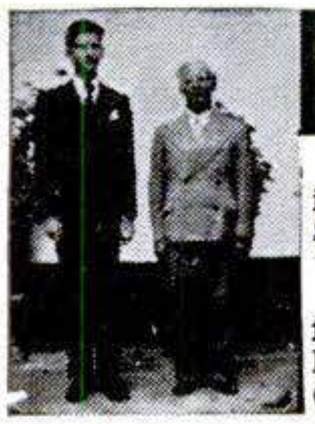

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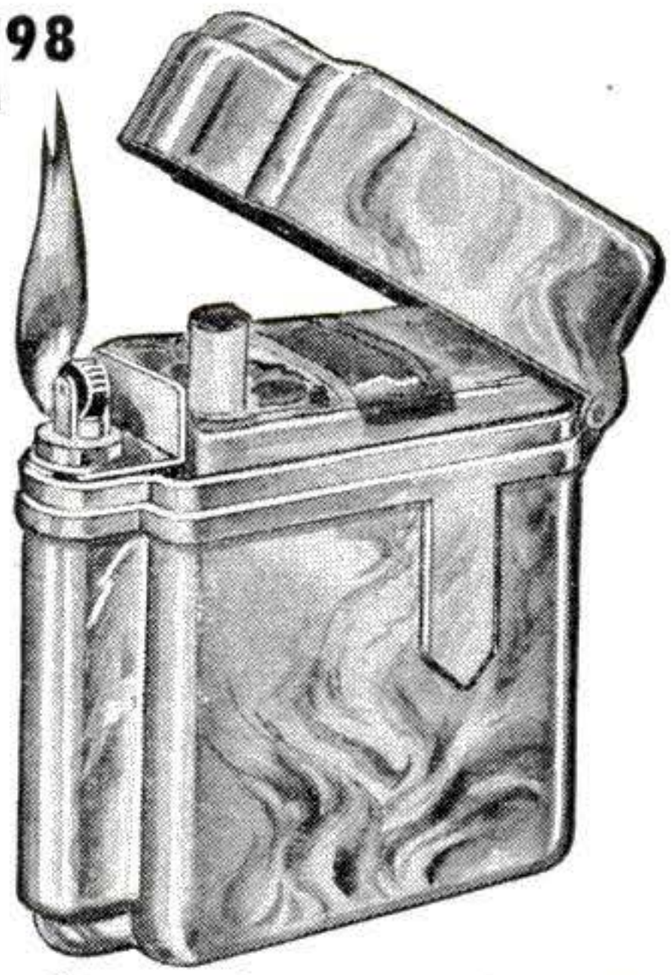

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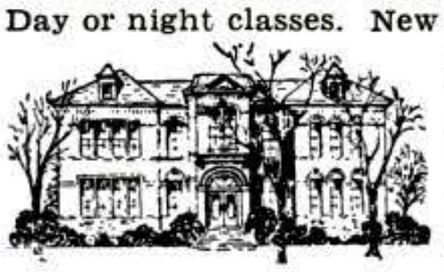

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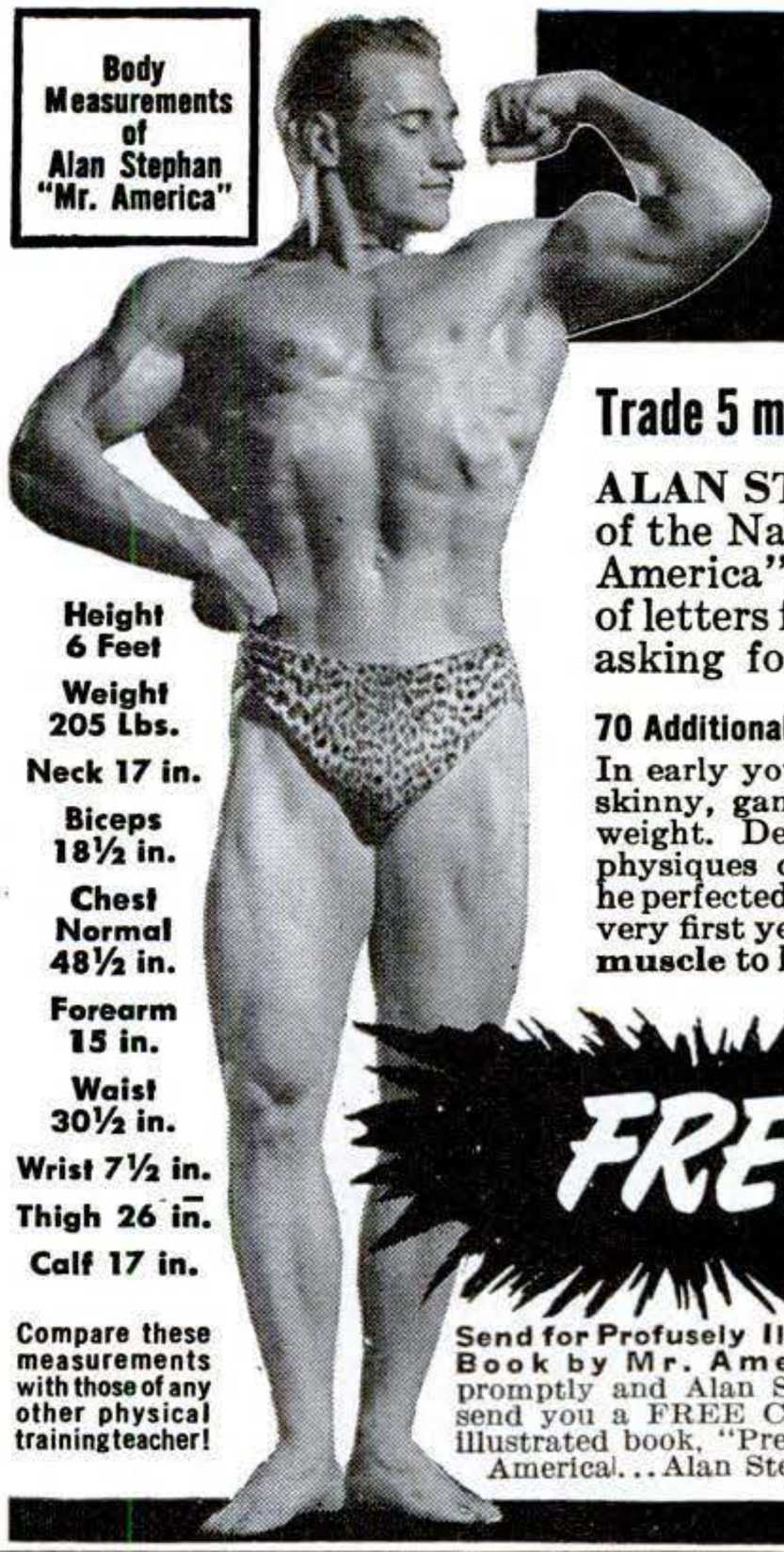

Height 6 Feet
Weight 205 Lbs.
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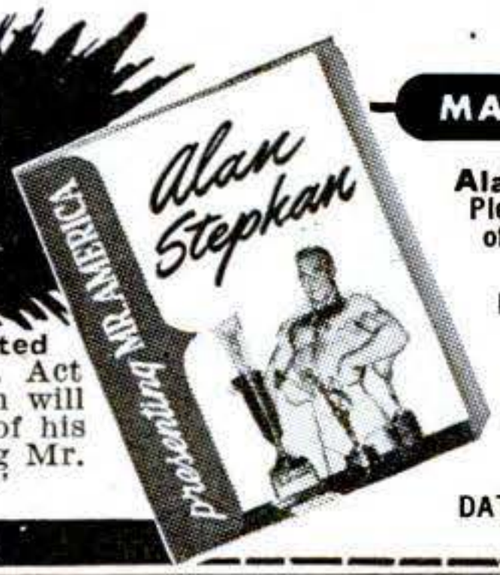

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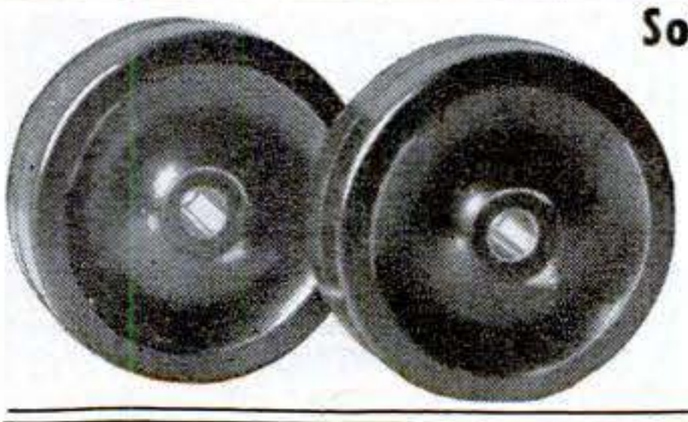

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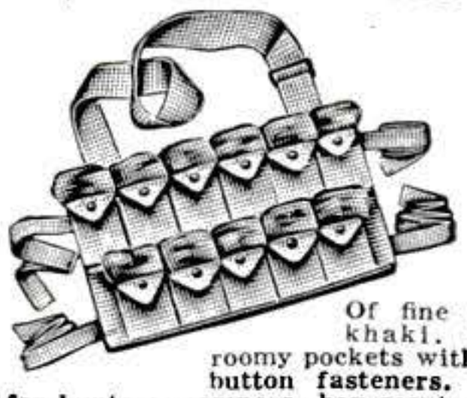


Of fine heavy khaki. Big roomy pockets with snap button fasteners. Fine for hunters, campers, boy scouts, etc., also for shop work in carrying small parts, etc. Material alone is worth this price.

11 Pocket Type **No. 129. EACH** **49c** | 5 Pocket Type **No. 128.** Each. **29c**

BOMB PARACHUTES

Of fine white rayon fabrics 5 x 8 feet in diameter with split seam for directional dropping.

Designed for dropping fragmentation bombs, emergency rations, etc. Each packed in a metal container. Weight 6 lbs.

No. R-162 Each only **$1.95**

WOOL ARMY BLANKETS

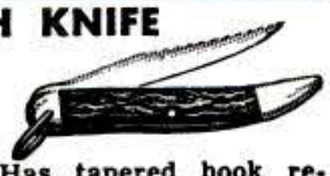
100% wool, regulation OD, Army blankets. Class B, perfect. Used but renovated for re-issue. Wgt. 5 lbs. **No. 233.** Each..... **$4.89**

SATCHEL POUCH

Heavy canvas pouch. Ideal for toting lunches, shopping, books, etc. Has three 11x12 inch pockets.

Brand new, guaranteed perfect. **A 1 1 3 —** Each..... **$1.69**

FISH KNIFE



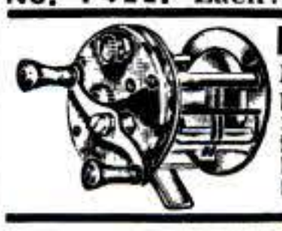
For your fishing tackle box. Bone handle 5" long. 4 in. blade with safety catch. Has tapered hook remover at end. Shp. wgt. 1 lb. **No. 548.** Each..... **$1.95**

2-Pc. Rain Suits

New 2 piece rain suits. Of durable wear resisting water and wind repellent OD fabric. Bib style pants, zipper fly. Jacket has parka attached. Guaranteed 100% weatherproof. Small, medium and large sizes. Shp. wgt. 3 lbs. **No. R549** Each.... **$4.95**

TELESCOPING BAIT and FLY ROD

Combination 4 piece telescoping bait and fly casting rod. Screw locking reel seat. Cork grip. Snake guides. Extends to 9 feet, telescopes to 38 inches. Shp. wgt. 1 lb. **No. F411.** Each..... **$3.65**



LEVEL WIND ANTI BACK LASH REEL

Highest quality with chrome plated frame: 3 piece take down design, 4x gears, bronzed bearings and jeweled spool caps. Spool diameter 1½ ins; pillar lengths 1½ ins. Capacity 100 yard line. Onyx head ring. Shp. wgt. 1 lb. **No. 450 F.** Each only..... **$8.55**

POPULAR RECORD ASSORTMENT

Fifty records of modern dance, race, blues and hillbilly selections. No two alike. Famous name bands and artists included. Used in juke boxes, but guar. perfect. Shipped exp. collect only—no exchanges or refunds. Wgt. 28 lbs. **No. A303**— 50 records **$9.64**

No. A300—25 Records. All Dance. Wgt. 14 lbs..... **$4.88**

No. A301—25 Records Hillbilly, Race and Blues. Wgt. 14 lbs. Set **$4.88**

No. 302—25 Records All Hillbilly numbers Wgt. 14 lbs. Set... **$4.88**

PLASTIC 8-OZ. FLASK

For hunters, fishermen, scouts. Waterproof and transparent. Use it for liquids, matches, flies, bait, etc. Has screw cap top for liquids, plus full open top. 5½ x 4⅛ x 1⅛ ins. Hundreds of uses. Wgt. 1 lb. **No. A347.** Each..... **29c**

OXYGEN TANKS

A shatterproof, welded seam oxygen tank. Fits gauge listed above. Measures 5½x8 in. Internal volume 104 cu. in. Square inch pressure 1.4 cu. ft. Has ⅜ inch pipe thread vent. Shp. wgt. 2 lbs. **No. 537.** Each..... **49c**

DECORATIVE CHROME STRIPS

For your car, boat, furniture, etc. Highly polished chrome finished strips with clinched edges for flush mounting to any surface. The 3 pound kit provides approx. 43 pieces in lengths from 4 inches to 3 feet and ¼ to ¾ inches wide. Wgt. 4 lbs. **No. R-224**—3 lb. Assort. only **$2.00**

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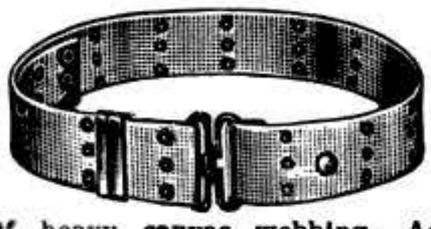
A "gold mine" for the radio serviceman. Hundreds of valuable radio parts, new radar and electronic parts and sub-assemblies, coils, resistors, trimming condensers—worth many times this low price. **A130R** —7 lbs. **$1.79**

G.I. PISTOL BELTS



Of heavy canvas webbing. Adjustable. Eyeleted all around. Used but perfect. Wgt. 2 lbs. **No. 131.** Each..... **98c**

HAND MICROPHONE

Top quality hand microphone with control button in handle. Highly sensitive. Has rubber covered cord and tel. plug. Fine for use on home recorders, public address systems, etc. Brand new — perfect. Shp. wgt. 2 lbs. **Stock No. 170.** Each..... **$1.95**

BAYONET BLADE

Fine forged steel. Ground but not polished. May be made into throwing or hunting knife or spear. Blade 6¾x⅞ inches, 11¾ inches overall. Will take and hold a fine edge. Shp. wgt. 1 lb. **No. 664-R.** Each... **49c**

MESS KITS

Regulation two piece Army Mess Kits with folding handle. Used, but perfect. Weight 2 lbs. **No. A116.** Each **69c**

CANTEENS

Reg. U.S. issue canteens. Plastic screw top chained to body. Slightly used but perfect. Wgt. 1 lb. **No. 117**—Metal. **No. 118**—Plastic. Each..... **69c**

CANTEEN CUPS

All metal. Folding handles. Wgt. 1 lb. **No. A120.** Each..... **25c**

CANTEEN COVERS

Heavy canvas. Button fastener. New **No. 530.** Each..... **69c**

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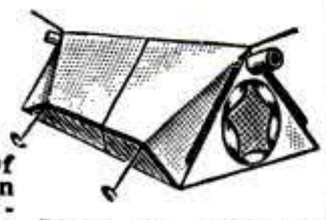
For back yard, country home and camp use. Has waterproof roof with mosquito-proof nylon netting side. Lets you sleep outdoors safely. Finest construction. Originally designed for U. S. Army use. Shp. wgt. 7 lbs. **No. 134.** Each..... **$9.95**

2 MAN MOUNTAIN TENT



Regulation Army type two man mountain tent, complete with poles, guy ropes, etc. Of durable nylon with reinforced seams. Ideal for outdoorsmen, campers, etc. Shp. wgt. 10 lbs. A splendid value. **Stock No. 202.** Each..... **$9.95**

PUP TENTS

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children. Wgt. 5 lbs. **A-100** Tent only..... **$3.95**

A-110 Tent, New.....$7.95

A-101 Ropes, wooden poles and stakes for above. Per set.....$1.00

SHATTERPROOF GOGGLES

All purpose type. Sponge rubber frame. Red shatterproof flexible lens. Adj. head band. With case. New. Wgt. 1 lb. **No. 139.** Each..... **39c**

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Purchased from Gov't. Used but perfect. For cameras up to 8x10 inches. Folds to 32 inches, extends to 58 inches. Needs adapter to mount camera. Wgt. 5 lbs. **Stock No. 190.** Each.... **$4.95**

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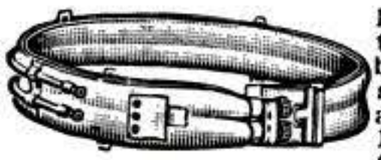
LIFE PRESERVER BELTS



Right from the invasion beaches. Consists of two air chambers. May be inflated automatically with "sparklet" cartridges or manually by attached hose. Adjustable in waist size. One air chamber guaranteed air tight—other may need a tire patch. All belts are used and slightly soiled—but a bargain at this low price. **No. 1261.** Each..... **$1.00**

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LARGE stock Indian parts. Expert motor rebuilding. New and rebuilt Chief Motorcycle, motors only. Indian Motorcycle Sales, Kansas City 1, Mo.

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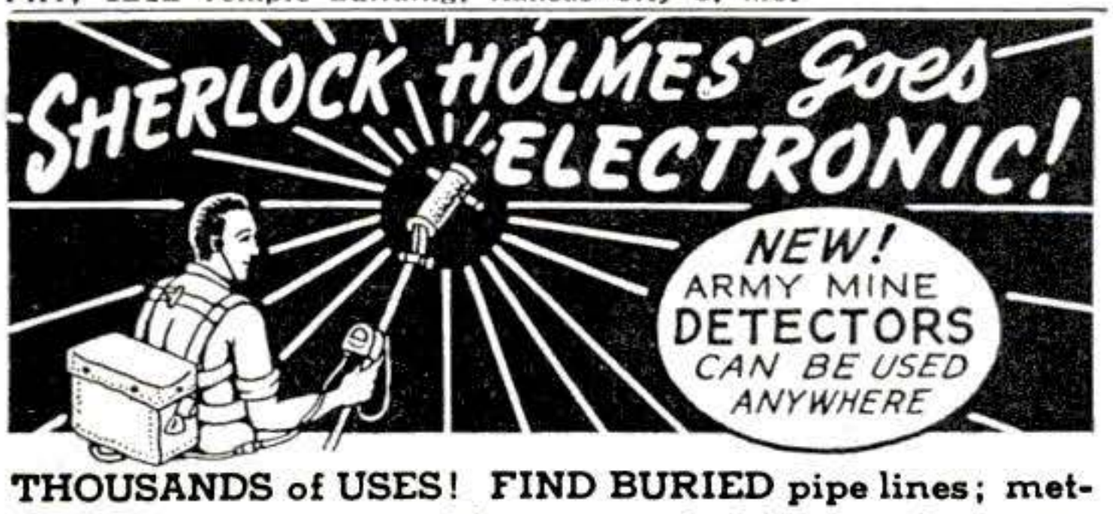

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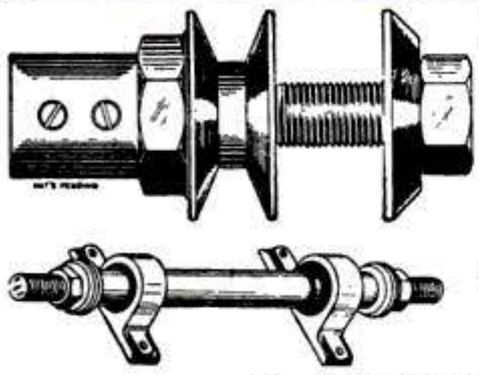

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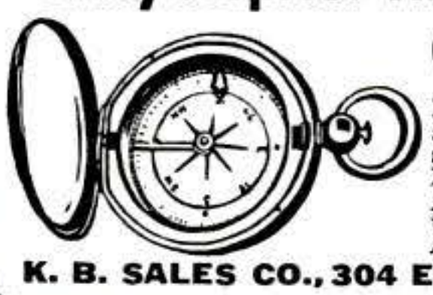

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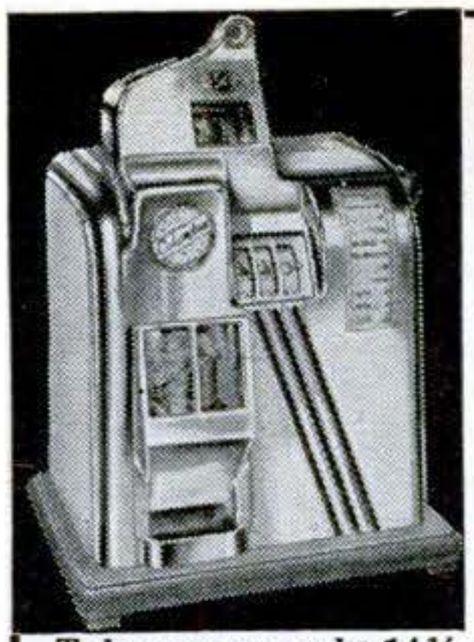

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Going Up for Keeps

By MARTIN MANN

THERE may be a new moon next May —literally. For the first time in history, brand new satellites are expected to join our familiar ball of green cheese on its lonely circle of the earth. And they will be made by man himself: small fragments of steel from the war head of a V-2 rocket, destined to spin forever far out in the earth's gravitational field.

These artificial moons will be tiny, so small that even the largest—about the size of a dime—will be invisible to the most powerful telescopes now available. If we could see them, however, they would be bright with light reflected from the sun, just like the old moon.

A V-2 bomb much like the kind the Nazis fired at London is expected to make this first permanent addition to the heavens. Its war head will be packed with a powerful, secret explosive. But instead of detonating when the rocket hits the ground, the charge will be set off by an automatic timer at the peak of the flight, about 100 miles above the earth. The terrific explosion will send pieces of the steel war head hurtling out into space at more than 25,000 miles an hour. That speed is more than enough, physicists calculate, to get many of the fragments so far up that they will never come down again.

On their way out in the heavens, the fragments will be pulled by gravity into a spiral around the earth. This spiral will widen quickly at first, then more and more slowly until it finally closes into an oval. That will happen when the outward centrifugal force caused by the spiraling around the earth just equals the inward pull of gravity. Forever after that moment the artificial satellites will spin in their oval paths, just like the old moon, although not nearly so far away.

Not all the fragments will follow this pattern. Since the explosion of the war head will send pieces flying in all directions, some will return to the earth, while a few

GLOSSARY for SKY SEARCHERS

PLANET—*one of the nine large bodies revolving around the sun. We live on the planet named Earth, which is the third out from the sun. Nobody is sure whether other suns have similar families of planets.*

SATELLITE—*any body that revolves around a planet. Satellites come in various sizes, but all are smaller than their planets; our single moon is a medium-sized one. The planet Jupiter has nine satellites, one almost twice as large as our moon, and Saturn has rings of very tiny satellites.*

COMET—*a loosely packed mass of solid matter that travels around the sun in big, elongated paths. When close to the earth comets can be seen by light reflected from the sun.*

METEOR—*a relatively small piece of iron or stone traveling in space, commonly called a shooting star. Some spin in paths around the sun, tagging after comets; others apparently roam aimlessly. About 50,000,000 small ones run into the earth's atmosphere every day, but they move so fast and are so tiny they burn up completely from air friction before reaching the ground. A few of the biggest ones get through and hit the earth; then they are called meteorites.*

ORBIT—*the path in which a heavenly body moves. The earth's orbit around the sun averages about 186,000,000 miles in diameter.*

GRAVITY—*the force with which any two objects attract each other. The earth's gravity gives us weight and makes things fall down rather than up. The sun's gravity holds the earth in its orbit.*

A V-2 much like the one at right, shown with the assembly platform still surrounding it, is scheduled to create the world's first artificial satellites. (See page 116 for more V-2 pictures.)

may zoom straight out into space and keep on going. Another group of fragments will start to spiral out from the earth, but the spiral will be too flat and they will soon spiral in again. When these fragments reenter the atmosphere, they will burn from air friction, looking and acting just like real meteors from outer space.

Astronomers won't be fooled, however, for they know exactly where and when to expect the real thing. These fake meteor showers, which may continue for a week or more after the rocket is fired, will be the only proof that the experiment worked. The artificial satellites themselves will be too small and too far away from the earth to be

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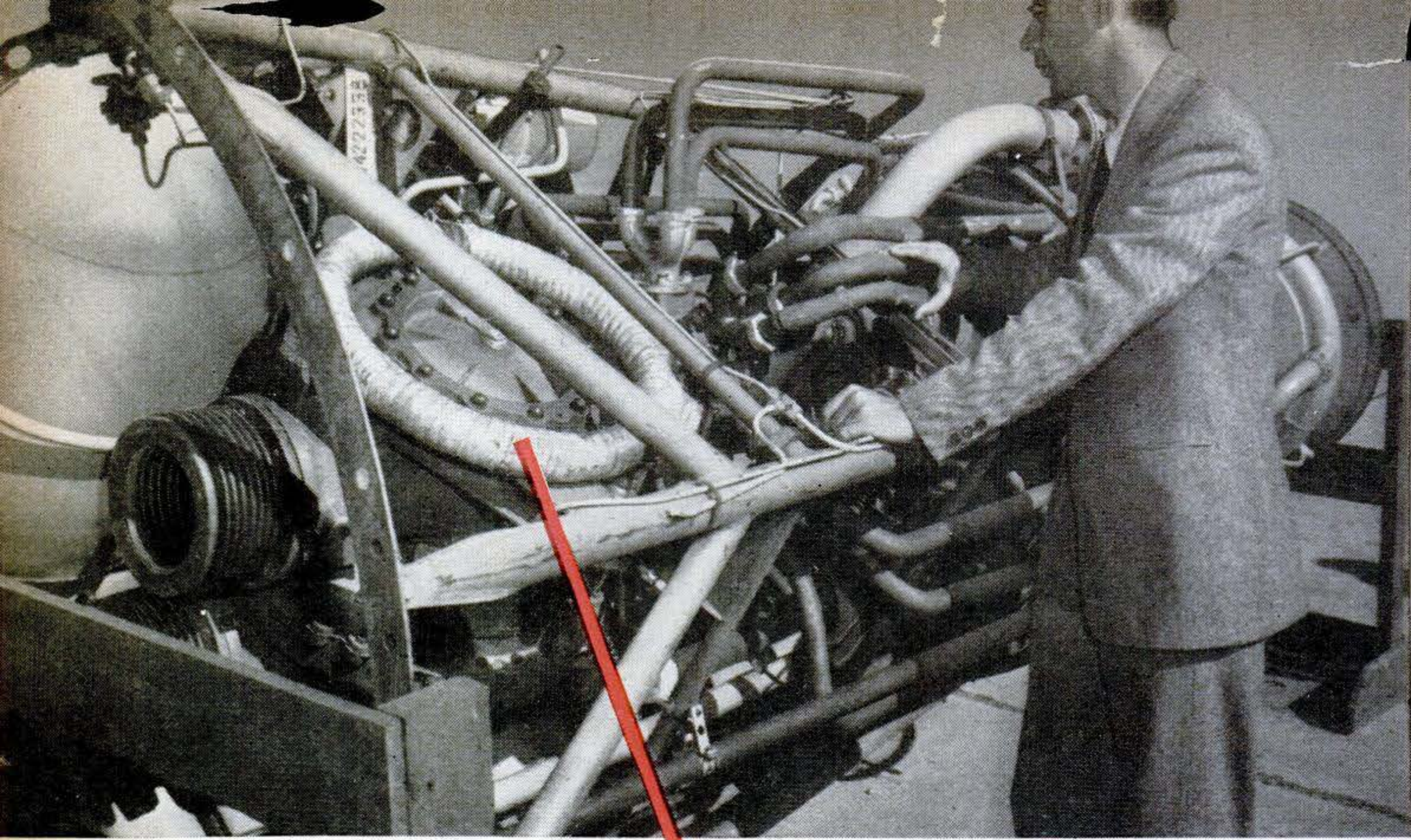
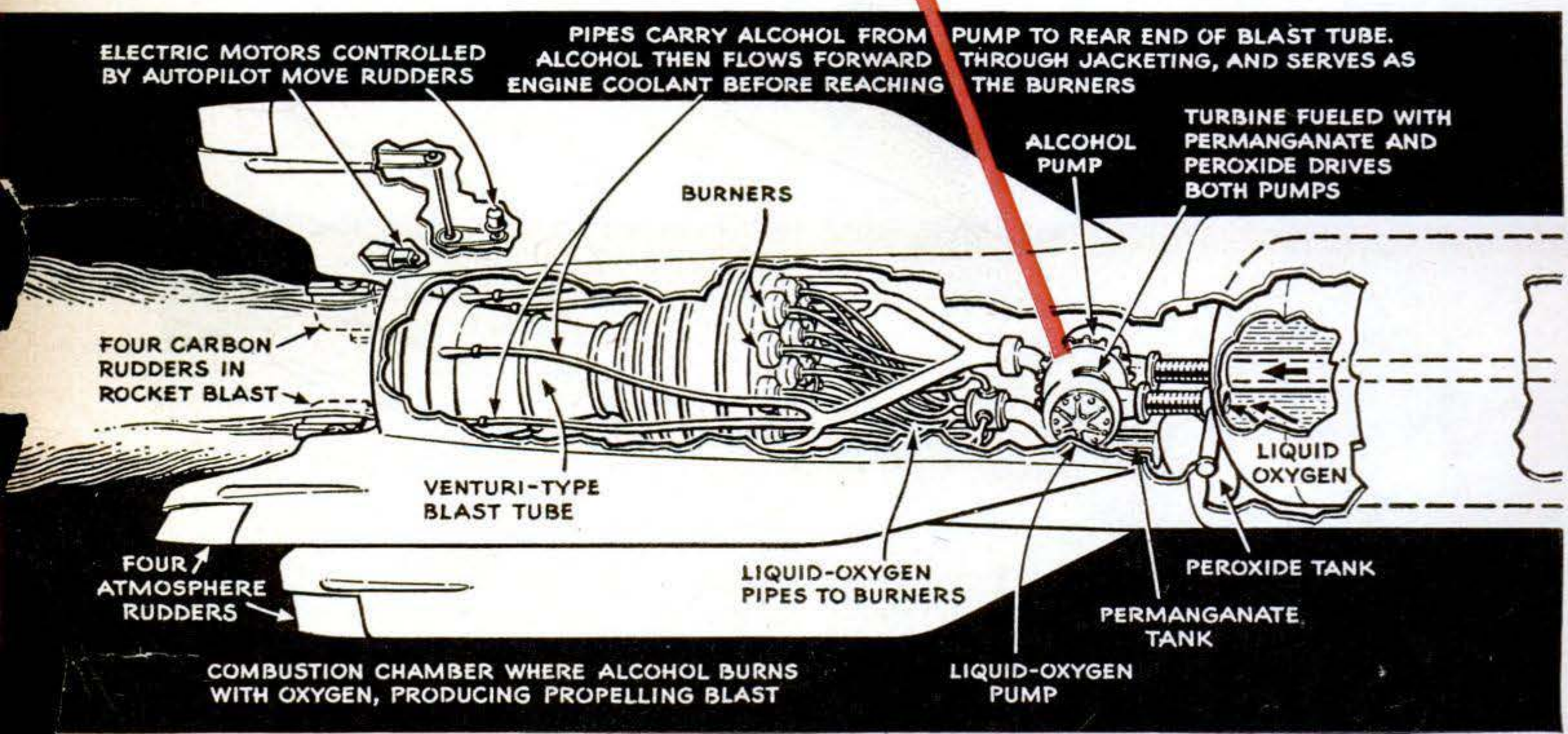


Dr. Ludwig Roth, one of the large group of German scientists now working with the American services, checks the complex tubes and valves in a V-2 engine.

detected by either telescopes or radar.

The special war head that will carry the artificial satellites to their starting point 100 miles up is being built at the New Mexico School of Mines. Co-operating in the experiment are the Applied Physics Laboratory of Johns Hopkins University, California Institute of Technology, Harvard University, and Navy, Army and Air Force units. Last December this same group fired the record-breaking V-2 that was to have produced the world's first artificial meteors.

Although the meteors from this rocket failed to appear, the test furnished information that is being applied to the satellite-making experiment. The source of these fake meteors was to have been antitank



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grenades fused to explode a few seconds after they were fired from cannonlike tubes in the head of the rocket. Grenade fragments have about the same size and speed as natural meteors and were expected to create a spectacular display of streaking fire 30 miles up in the night sky.

Now the scientists consider grenades too weak for the job. So the satellites will be produced by a much heavier charge of more powerful explosive filling the entire head.

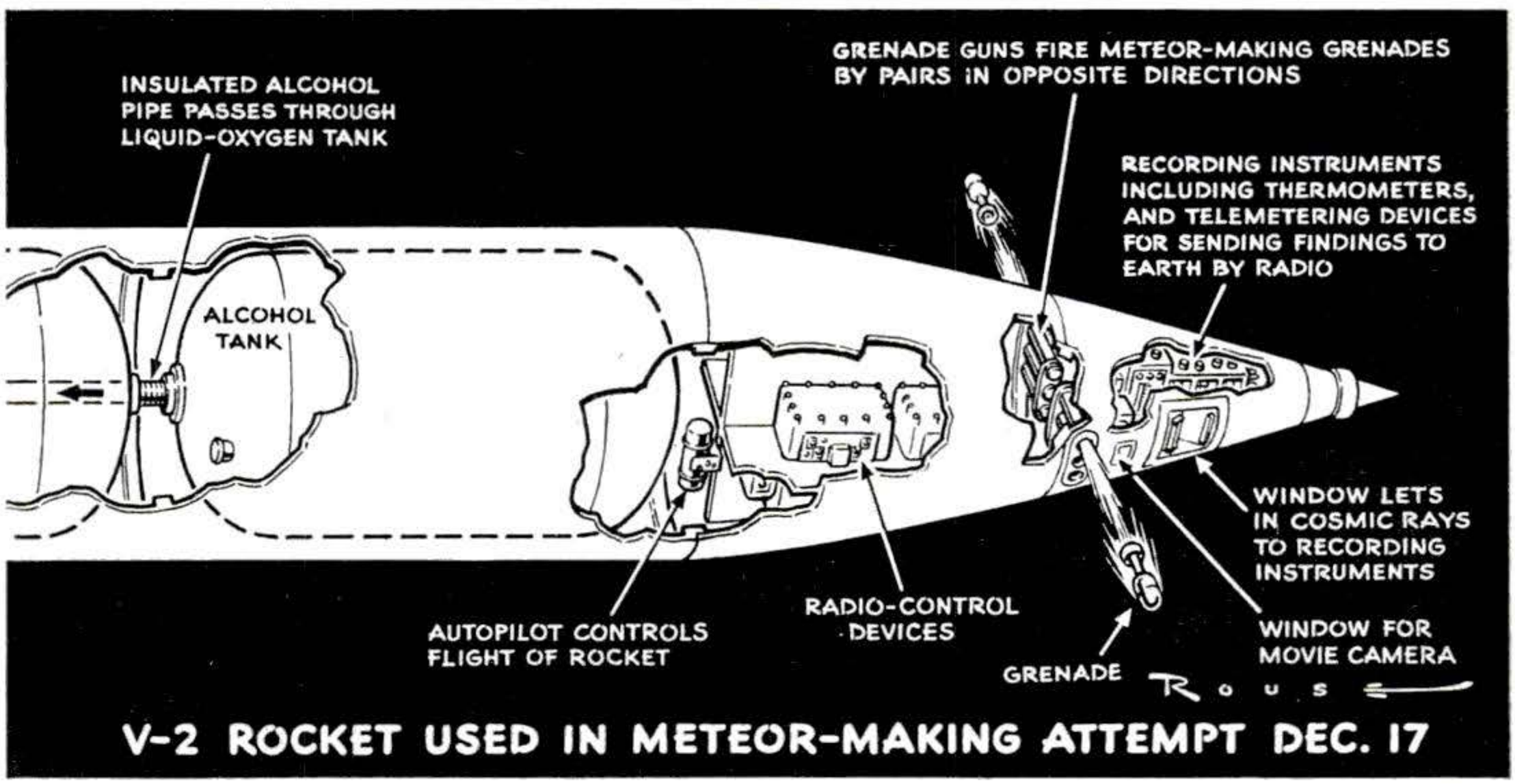
Another try at making meteors will probably be scheduled after the satellite experiment, for fake meteors could furnish much valuable information. As each fragment speeds across the sky, it flames from air friction. This streak of fire can reveal many of the secrets of aerodynamics at great altitudes. Right now we know practically nothing about this subject, yet we need the information badly. Airplanes will soon be flying at those heights. The Army Air Forces' XS-1, built to cruise 16 miles up, has already been flight-tested.

Artificial meteors would supply two facts aeronautical engineers want: the density and temperature of air in the ionosphere. Density and temperature at any altitude can be calculated provided you know the size, weight, starting speed and rate of slowing down for an object at that altitude. For man-made steel fragments, the first three of these facts can be determined by tests on the ground. The rate of slowing down, or deceleration, can be measured on photographs of the meteor track taken by special cameras. These cameras have rotating shutters, which interrupt the track at regular intervals, making it look like a line of shorter and shorter dashes.

Density and temperature data also interest radio engineers, for they may be connected with the effect the ionosphere has on radio reception. The E layer in the ionosphere, a band of ionized air (which is composed of electrically charged particles), reflects radio waves of certain frequencies. This reflection permits long-distance communications—the waves bounce back and forth between the earth and the E layer in a zigzag path to their destination.

But sometimes strange things happen in the ionosphere. Broadcasts that were coming through clearly one moment fade out completely the next. Scientists found this trouble was caused by changes in the density of the ions in the reflecting layer, which are in turn a rather mysterious result of disturbances in the sun. With precise information on the density of air in the ionosphere, the behavior of the E layer could be predicted more accurately.

In addition to prying out the secrets of the reflecting layers, the artificial meteors should teach us more about real meteors, which themselves affect radio reception. J. A. Pierce, of Harvard, believes they may cause a large part of the ionization of the E layer. And Bureau of Standards scientists report that they create the interference in FM broadcasts called bursts—snatches from distant stations superimposed on local pro-



V-2 ROCKET USED IN METEOR-MAKING ATTEMPT DEC. 17

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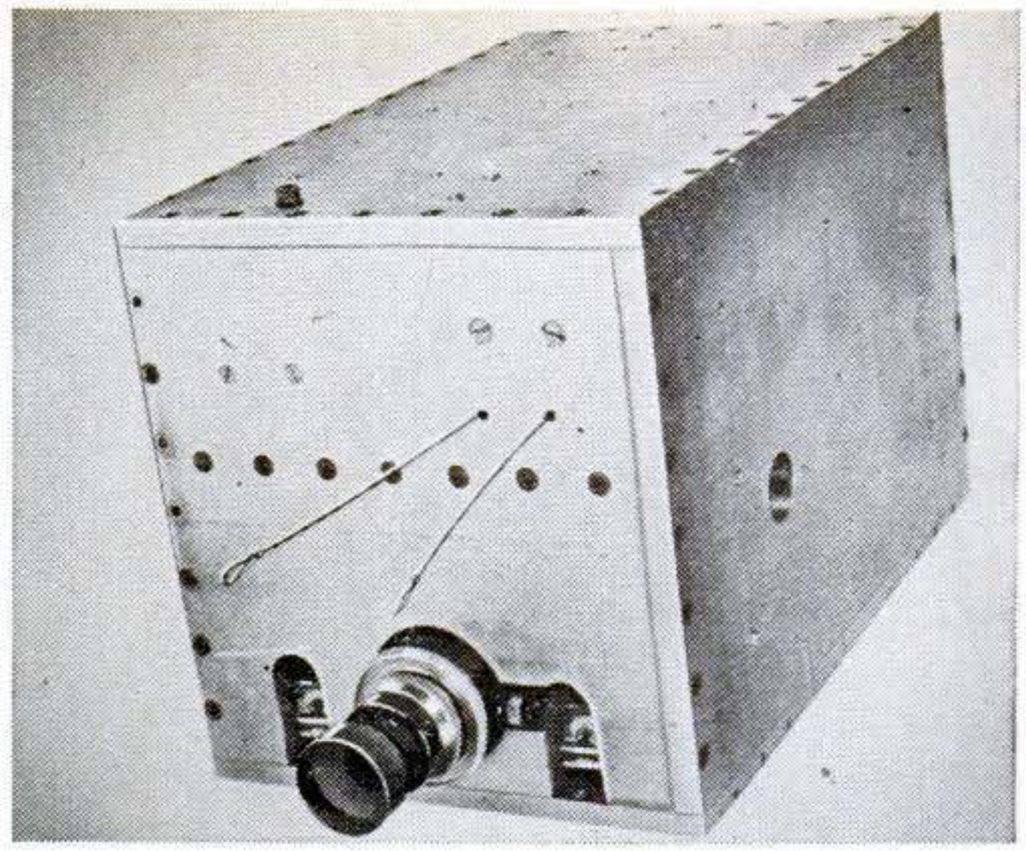
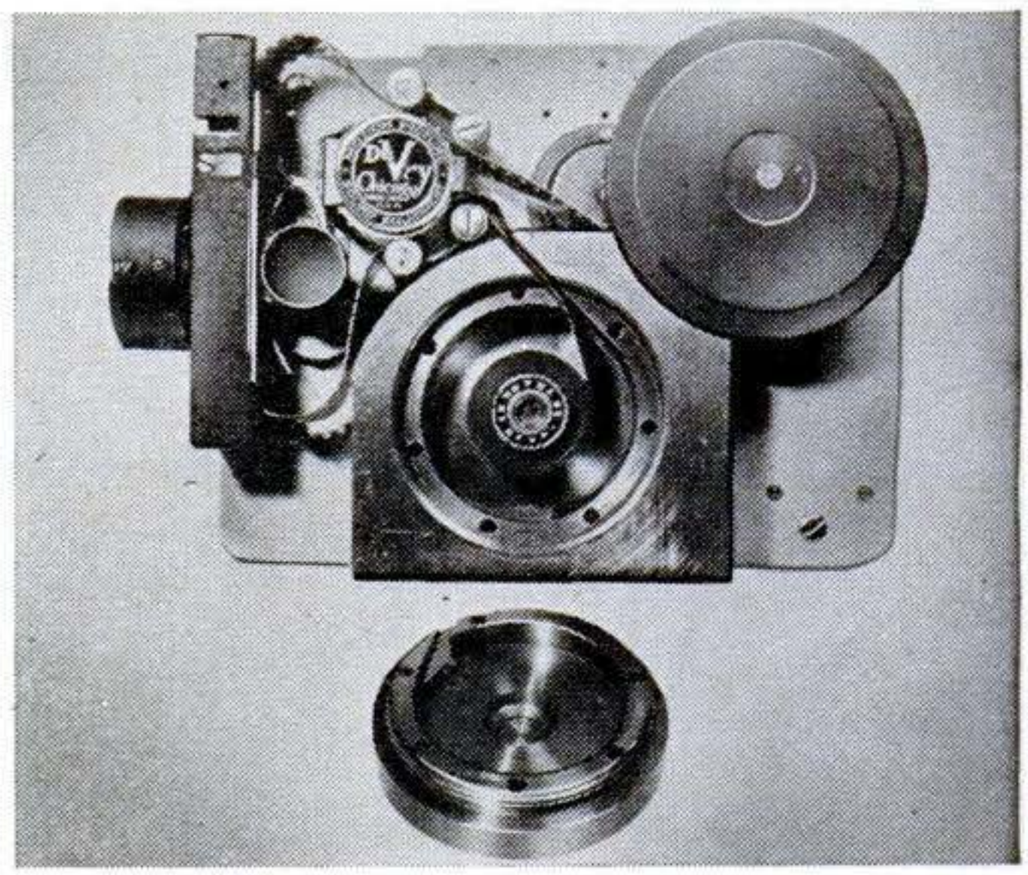
Clyde Holliday, photographic expert at Johns Hopkins Applied Physics Laboratory, examines what's left of camera that snapped the earth from a V-2.

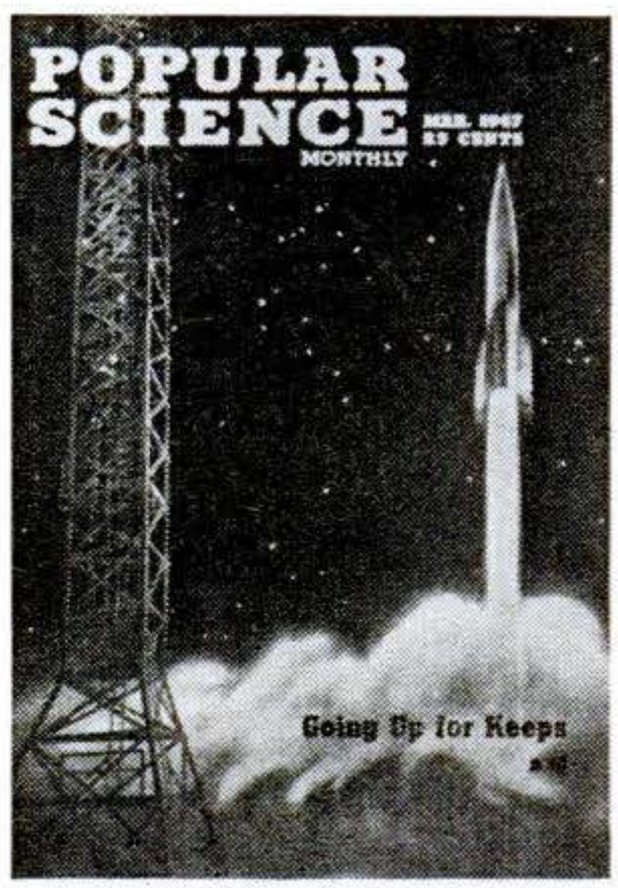




A special steel box protected the newsreel camera (upper right). The modified mechanism is shown at the right. Note the armor-plate take-up magazine.

grams. Bursts result when an FM wave hits the stream of hot, highly ionized gas in a meteor's trail (the visible part of a meteor). This ionized gas reflects the distant FM transmitter's wave back to the earth, where it comes through the loudspeaker scrambled with a local wave.

Radar will be used in many of these studies of meteors, for its high-frequency waves bounce back from meteor trails the way FM does. Government and university laboratories are already using this reconverted war weapon to track natural meteors. The meteors appear on the radar scope as a bright streak of light, or pip, and also make a whistling noise in the earphones. As the observers at Stanford University said, "It was not a celestial sound. It sounded like a bunch of sophomores whistling at a blonde a hundred thousand miles out in space."



COVER: The fiery take-off of an outward-bound V-2 lights WAC Corporals' launching tower. Painting by Ray Pioch.

Unlike the meteors, the fake satellites will serve no immediate purpose; they will be so small no one could even be positive they exist. Many of the warhead fragments will not become satellites, however, and will return to the earth as a shower of meteors. From the behavior of these returning fragments, observers will gather information similar to that sought in the meteor-making experiment attempted in December.

But the biggest result promised by next May's test is evidence that a solid object *can* be thrown beyond the ordinary pull of gravity. Man will finally have stuck his foot in the door to space travel. After that, the sky is no longer the limit. END

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How You'll Fly to the MOON

A critical moment on the first flight to the moon: Stage 2 roars out of its nest in stage 1 as the stage 1 fuel tanks run dry a few hundred miles up.

THE days of dreaming about a trip to the moon are over. The research destined to make that trip an actuality is already well under way.

Next May the first step on the long, long trail into space may be made: Man hopes to send something up that will never come down again (see "Going Up for Keeps," p. 66). In the words of Dr. Fritz Zwicky, the California Institute of Technology physicist who suggested the May satellite-making experiment, "We first throw a little something into the skies. Then a little more, then a shipload of instruments—then ourselves."

And other scientists agree. Dr. James A. Van Allen, of the Johns Hopkins University Applied Physics Laboratory, anticipates sending a rocket to the moon (one way, no crew) *within 15 years.* "A conservative estimate," he says. Maj. P. C. Calhoun, chief of the AAF's guided-missile branch, expects to travel to the moon and back in his lifetime. And the University of California at Los Angeles already offers a course in rocket navigation!

How the journey will be made is even now known in considerable detail. Rocket experts at Johns Hopkins and Caltech report that the space ship will look like this: A number of separate rocket motors (probably between three and five), each with its own fuel tanks

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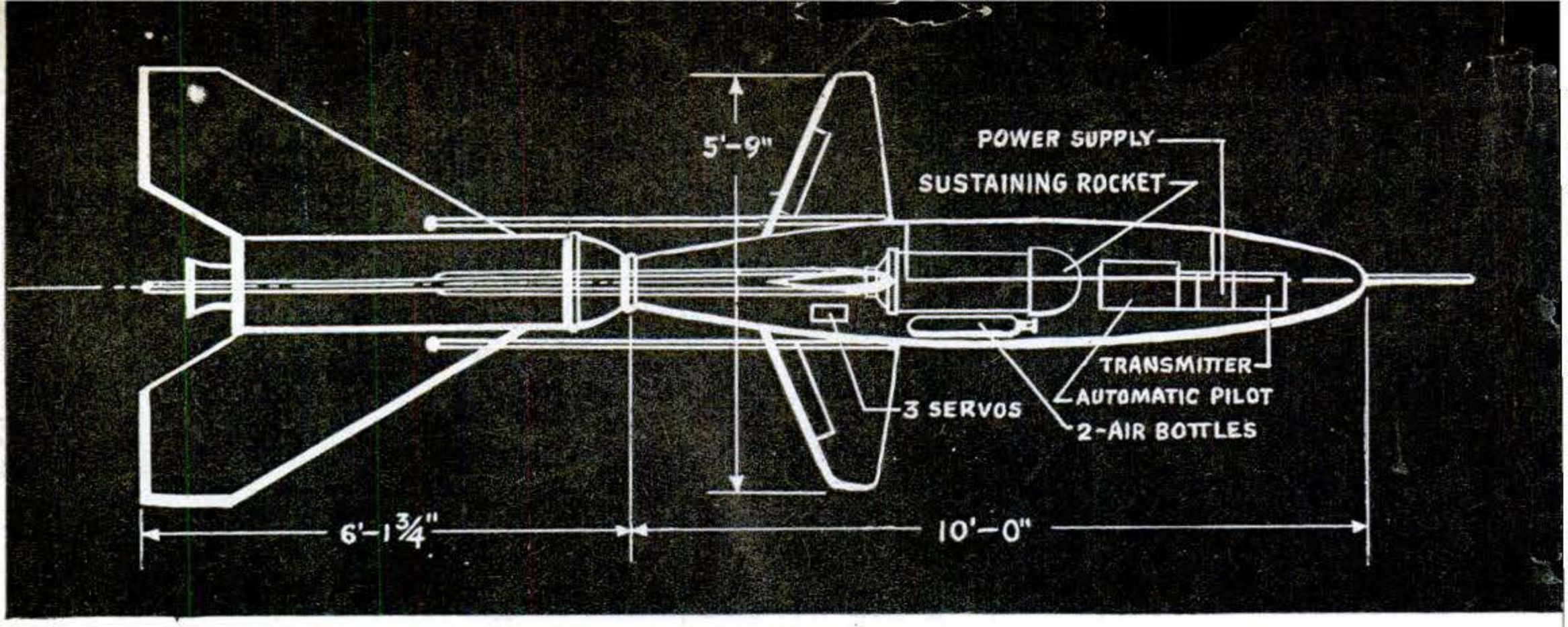

In the Tiamat, one of the first multistage rockets tested, the second stage is simply fastened to the front end of the first stage without the involved nesting arrangement needed for a moon rocket.

and controls, make up the power plant. The first motor, or stage, pushes the ship up a few hundred miles, when, its fuel exhausted, it is dropped off. The second stage then starts automatically and accelerates the ship until it uses up its fuel and is jettisoned. This process continues, each stage adding more speed, until the last stage completes the job of getting the 22,000-m.p.h. velocity needed to escape from the earth's gravitational pull. Once free of the earth, the space ship can coast to the moon (there would be no air resistance). Only a little power would be needed for steering.

The multistage system eliminates the dead weight of big, almost-empty fuel tanks and seems to offer the most economical method of securing extremely long range. Tests of one of the first practical rockets of this type have already been made.

This rocket, the Tiamat, developed by the National Advisory Committee on Aeronautics, has two stages. One of its most important features is an accurate control system that permits it to be flown through fairly complicated maneuvers. Although quite small—less than 15 feet long and weighing about 600 pounds—it is probably a good indication of the design of the moon rocket of the future.

The jump from the Tiamat's 600-m.p.h. speed to the 22,000 m.p.h. needed for a trip to the moon is a big one, but not impossible. Twenty-two thousand miles an hour is not as fantastic a speed as it seems. The single-stage V-2 already gives 3,500 m.p.h., and succeeding stages would have the big advantages of reduced gravitation and complete absence of air resistance—both important factors.

Not that you can ride to the moon by hitching three V-2s together. If a multistage rocket uses a V-2 for the *first* stage (that, essentially, is the satellite-making rocket to be fired during May) the pay load in the *final* stage is a steel fragment smaller than a dime. Engineers can also calculate how big a ship able to reach the moon would be if its final stage were a V-2. Alfred Africano, pioneer in rocket development and now project engineer for the Curtiss-Wright Corporation, did the arithmetic. The answer is 5,500,000 tons.

But these calculations are based on the motor and fuels employed in the V-2. Although this power plant is the most efficient now known to be in use, it still needs nine tons of liquid oxygen and alcohol and four tons of motor and airframe to lift a one-ton pay load. Much higher efficiencies are reported to be possible with fuel and motor combinations already being tested by the rocket researchers.

Better fuels—that is, hotter fuels—have been available for a long time. Rockets run on heat. The hotter the gases in the combustion chamber, the greater their pressure, the higher their speed as they shoot out the nozzle, and the faster the rocket is pushed ahead.

On that basis, hydrogen and oxygen would make the most effective fuels. When these two elements combine to form water, the reaction releases more heat per pound than any other now known. The best rocket would actually be a steam engine! Using hydrogen and oxygen as fuels, a moon rocket would need only five stages, according to the calculations of Martin Summerfield, of California Institute of Technology, a leading American authority on rockets. It would be

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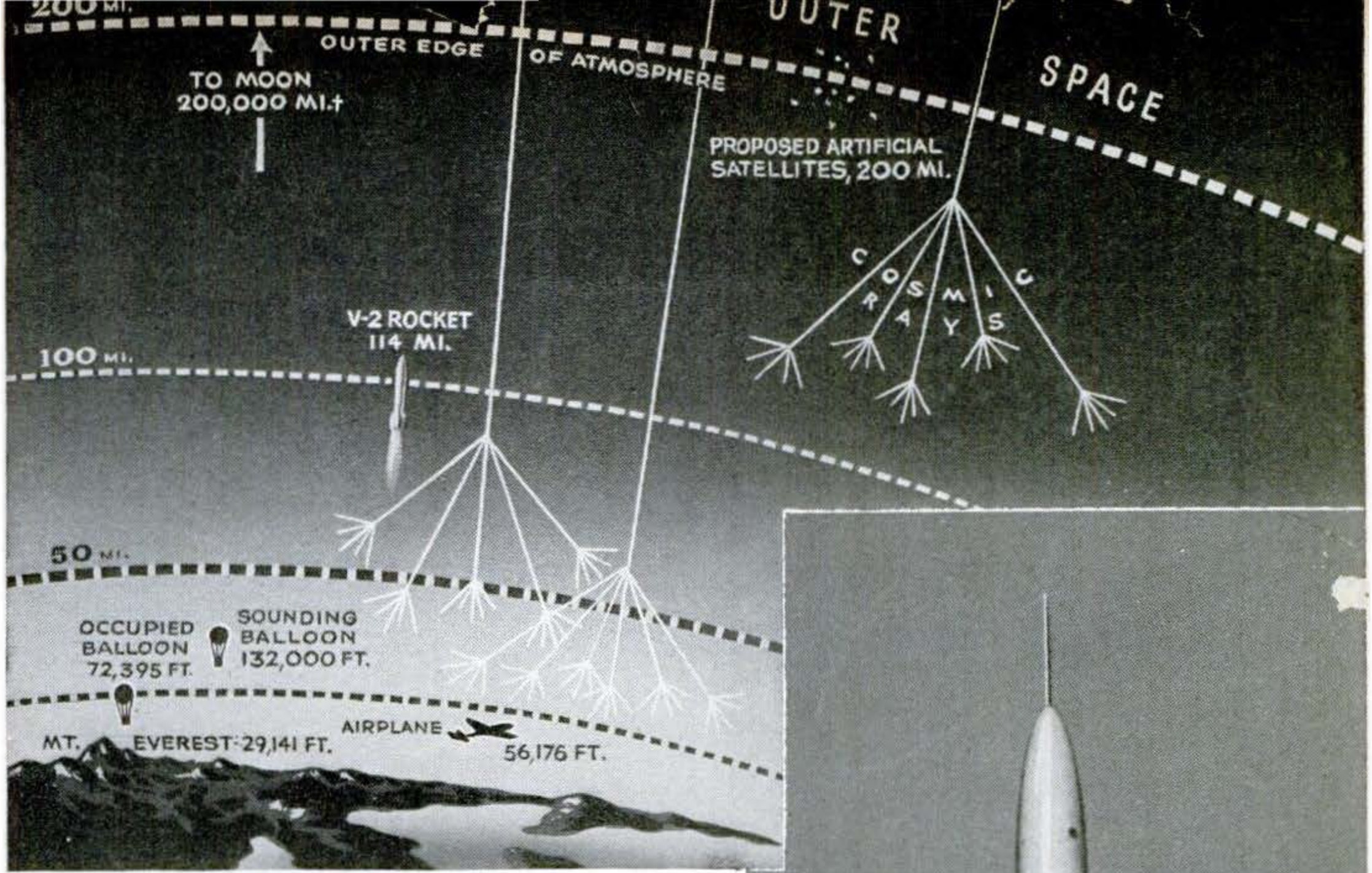


The ceiling over man's upward journeys is rapidly being raised, as shown in the drawing above. Much information on cosmic rays may come from higher trips (see "Why B-29s Hunt Cosmic Rays," p. 121).

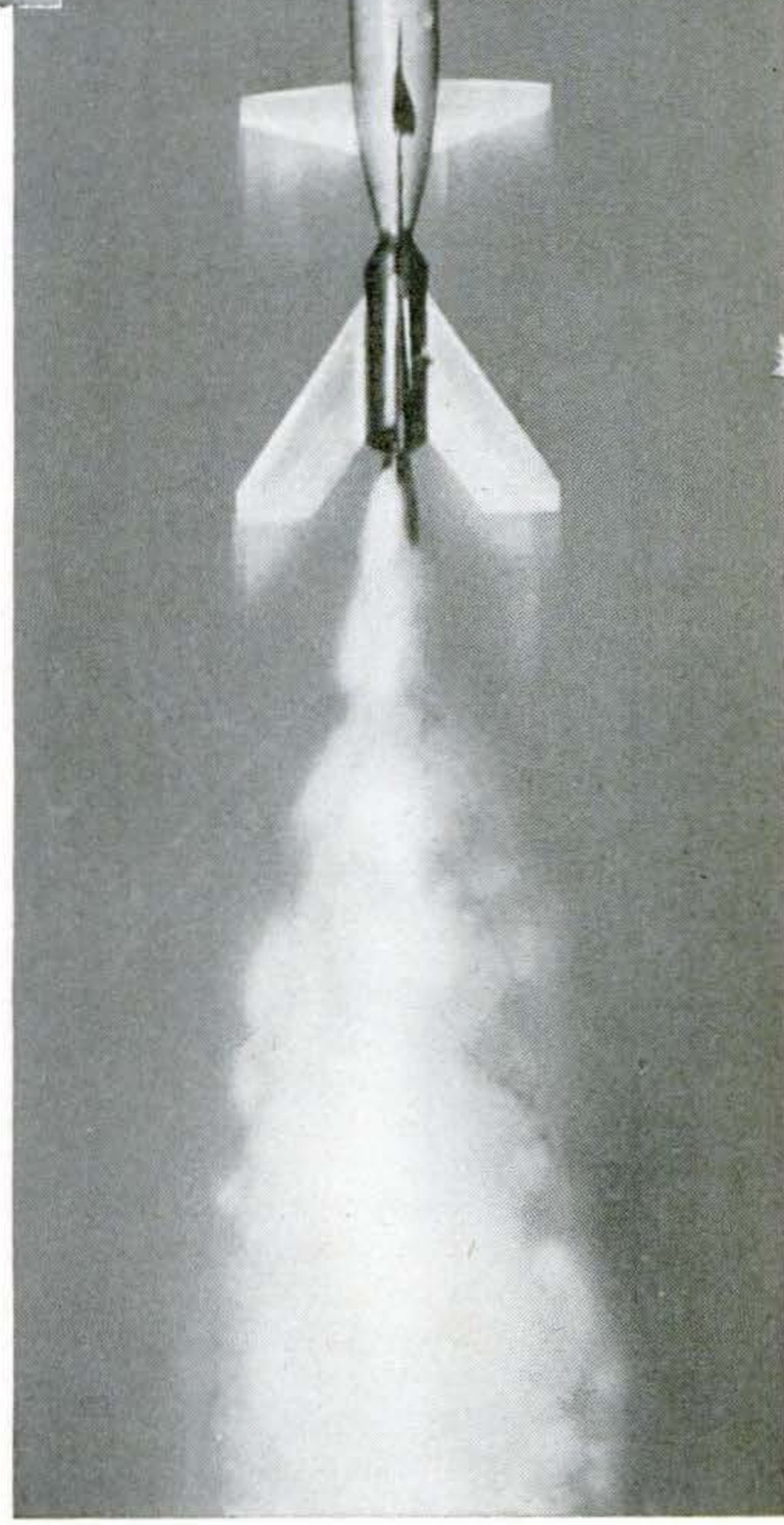
72 feet long and would weigh about 25 tons, about twice the size of the V-2.

Yet the tremendous heat available in oxygen and hydrogen—the characteristic that makes them so desirable—is the very reason they are not used. No lightweight motor can stand that temperature.

Present rocket motors are cooled by double-walled jackets through which one of the fuels is pumped. The fuel takes heat away from the motor and at the same time is warmed up itself for easier burning in the chamber. Ethyl alcohol, the V-2 fuel, works very well; its rate of burning (which determines how fast it is pumped through the cooling jacket) is about the same as its rate of heat absorption. For hydrogen, this is not true. It absorbs less heat per pound and must therefore be pumped through the cooling jacket, and burned, faster. The result is an inefficient flame—or else the motor burns out.

If hotter fuels are to be used, new heat-defying motors must be made. Research in that direction has already been quite successful.

One group of materials that can withstand



Tiamat's first stage, shown here operating at start of flight, runs for 3½ seconds. Then it drops off. Top speed, secured with second stage, is 600 m.p.h.

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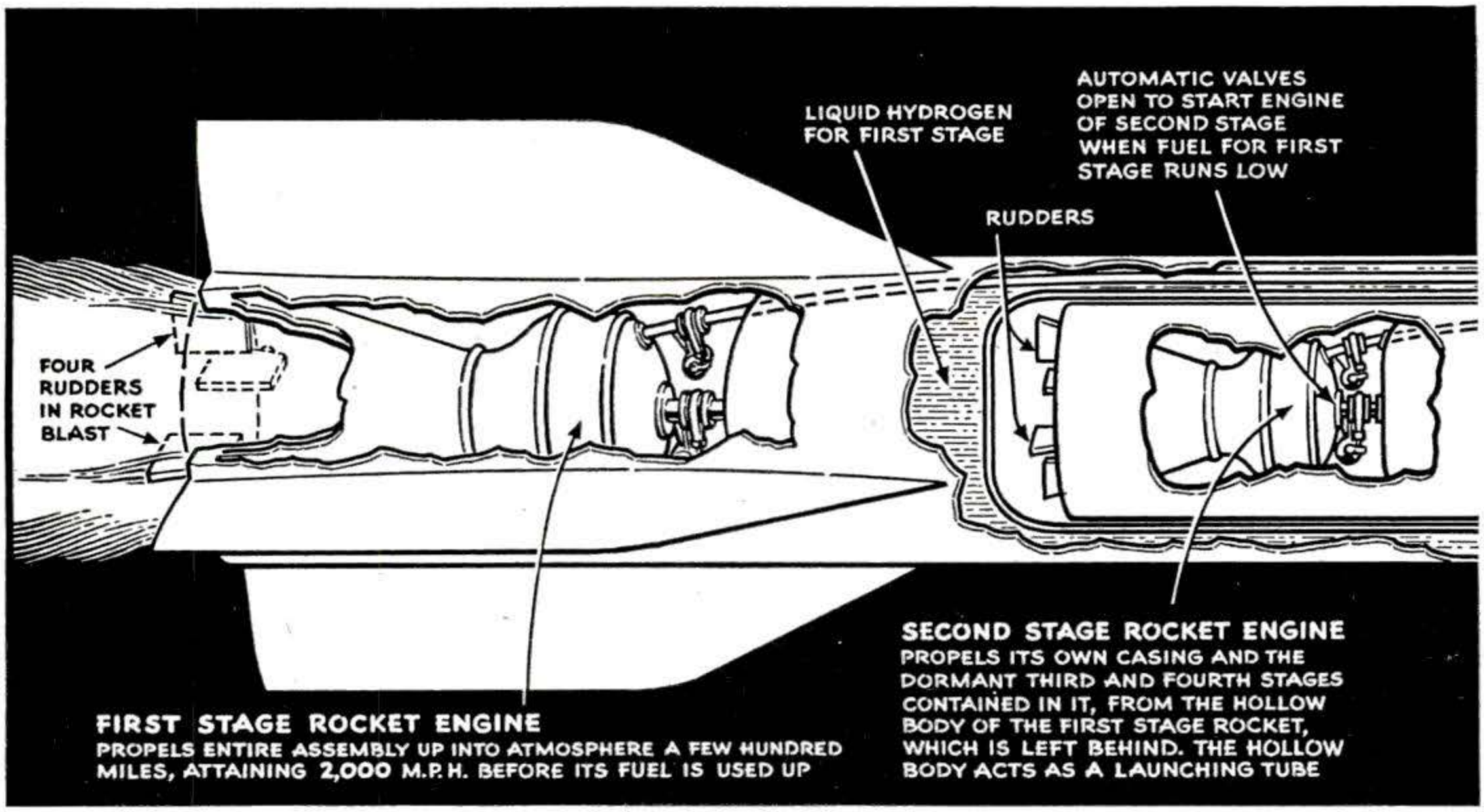
almost any temperature is ceramics—basically the same thing as dinner china. A ceramic motor, or motor lining, would never burn up. The problem is to make it strong enough. And recent advances in the ancient art of pottery making promise ceramics that will hold together under thousands of pounds of gas pressure.

Another possibility is powdered metal—finely ground metal dust that is solidified under terrific heat and pressure. Powdered-metal parts are hard, strong and porous. In a powdered-metal rocket motor, the tiny holes would permit much of the heat to escape outside to empty space.

A rocket with a ceramic or powdered-metal motor, using the most powerful chemical fuels and constructed with extremely light, strong materials, seems certain to be able to make a one-way trip to the moon. This is the feat scientists foresee before 1962—and maybe in 1948. But a one-way rocket could carry no men.

Building a true space ship—one that could take a crew up and back—is far more difficult because the pay load necessary is many times greater. To the weight of the men themselves must be added the weight of the things needed to keep them alive: a strong, airtight cabin; air, food and water supplies; some kind of cooling system to keep them from baking to death under the direct blaze of the sun, which would no longer be impeded by the blanket of air protecting the earth; and perhaps equipment to safeguard them against cosmic rays, too. Most important, however, is the weight of fuel for the return flight and braking during landings. Even with the best chemical fuels, operating at 100 percent efficiency, a round-trip rocket would be unreasonably large.



The fuel that *can* do the job is plutonium or uranium. About five pounds of uranium are enough for a round trip to the moon with a one-ton pay load. Only one stage is necessary.

In an atomic rocket a new feature, the "working fluid," would be added. The fuel —uranium—would not be ejected itself, as in a chemical rocket, but would heat up the working fluid, which would then be shot out of the base of the rocket to furnish the propelling power. The working fluid is required because a nuclear motor gives off energy in all directions—half the fission particles would fire out of the nozzles to push the space ship up, but the other half of the radioactive fragments would fly forward and heat up the fuselage. In fact, they would heat it up to about 28 *million* degrees! The working fluid traps all this energy, more than doubling the efficiency of the rocket, as well as preventing the passengers from burning up. Hydrogen, the lightest element, promises to be the best working fluid.

Few scientific obstacles stand in the way

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of an atomic-powered space ship. The one big task remaining is the design of a small, lightweight "pile" capable of releasing large, controllable amounts of power.

And recent statements by leading physicists associated with the atomic-energy project indicate that such a power plant can be expected soon, perhaps within 10 years. Then the Buck Rogers boys will really take over.

To the first crew, the ride would be uncomfortable, at the very least. The cabin would have to be small, with food and water supplies extremely limited. The acceleration during the start would push the men down into their seats with a force equal to five times the pull of gravity—about the same thing the pilot of a fast fighter plane feels in a tight turn.

As for danger, there would be plenty of it. The foreseeable risks—such as running out of fuel, getting lost, breakdown of the air-conditioning system, etc.—are probably minor compared to the hazards we won't know anything about until after a trip is actually made. The harm to be expected from cosmic rays, those high-speed particles so plentiful in the upper atmosphere, is already being measured by instruments carried in V-2s. The danger of running into a stray meteor can be forgotten; the chances are a million to one against it.

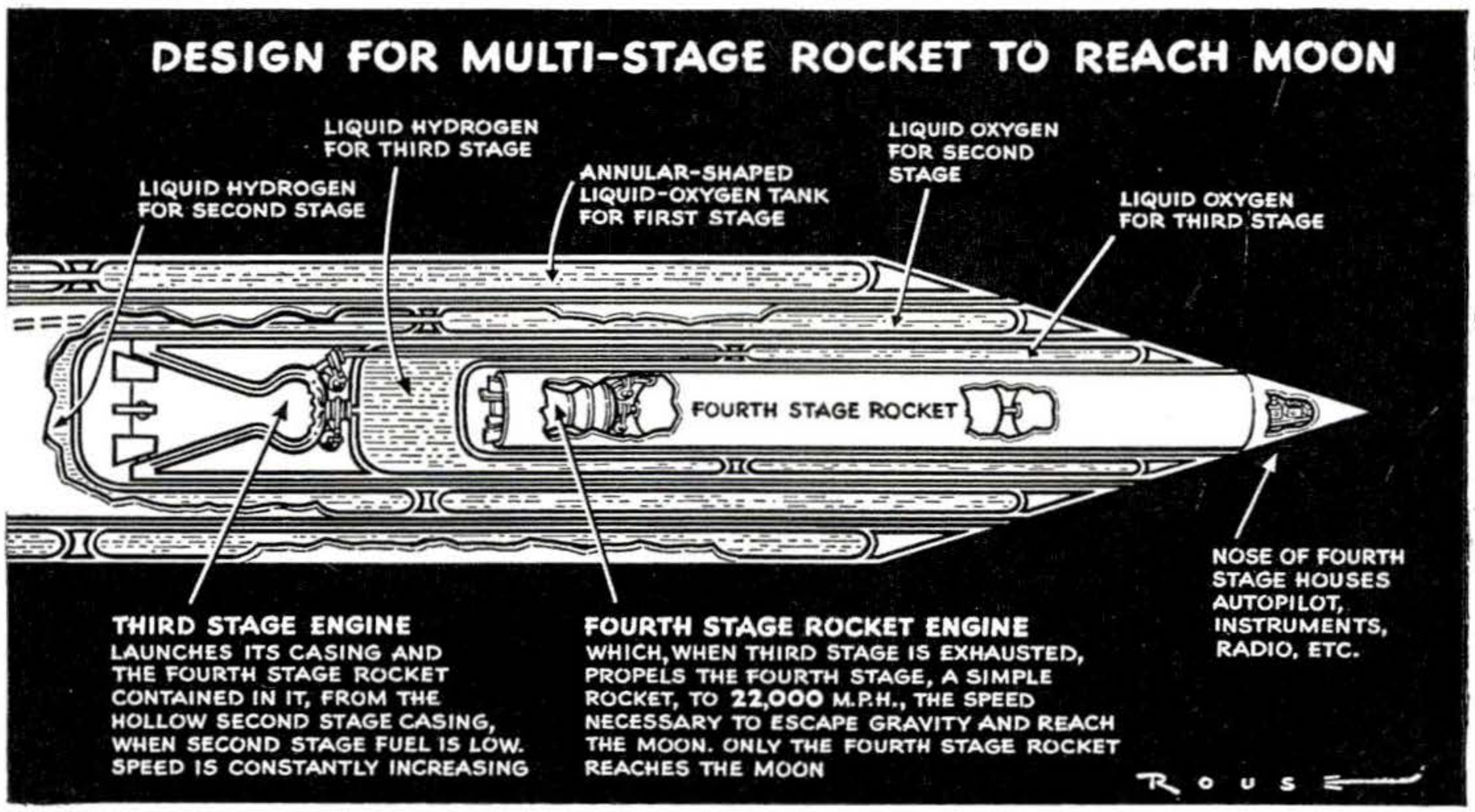
These first space travelers will find their itinerary all set, and complete with road maps. The astronomers, already well acquainted with at least one side of the moon, want to know what lies under the dense clouds that completely obscure the planet Venus; what is on Saturn, always hidden by its big rings of satellites; and what is the meaning of those strange lines on Mars—the so-called "canals."

But our old, friendly moon would probably be the first stop on any space route. First of all, it's close. The 240,000-mile trip could be made in about 12 hours by a rocket traveling 22,000 m.p.h., the final speed needed to shake free from the earth.

And we already know a great deal about the moon—more than we know about some parts of the earth, in fact. Its geography has been fairly accurately mapped (but only on the side facing the earth; the other side is a complete mystery). Its temperature has been recorded. It has little or no atmosphere.

The moon's small size, which gives it a gravitational pull one-fifth that of the earth, is another advantage. Less power would be needed to get away for the return trip.

But all these plans must wait for the two basic elements: more powerful, lighter fuels; and motors to withstand their heat and pressure. So don't rush to your travel agent. You won't be able to buy a ticket for the moon tomorrow, or even the next day. But the day after that. . . . END



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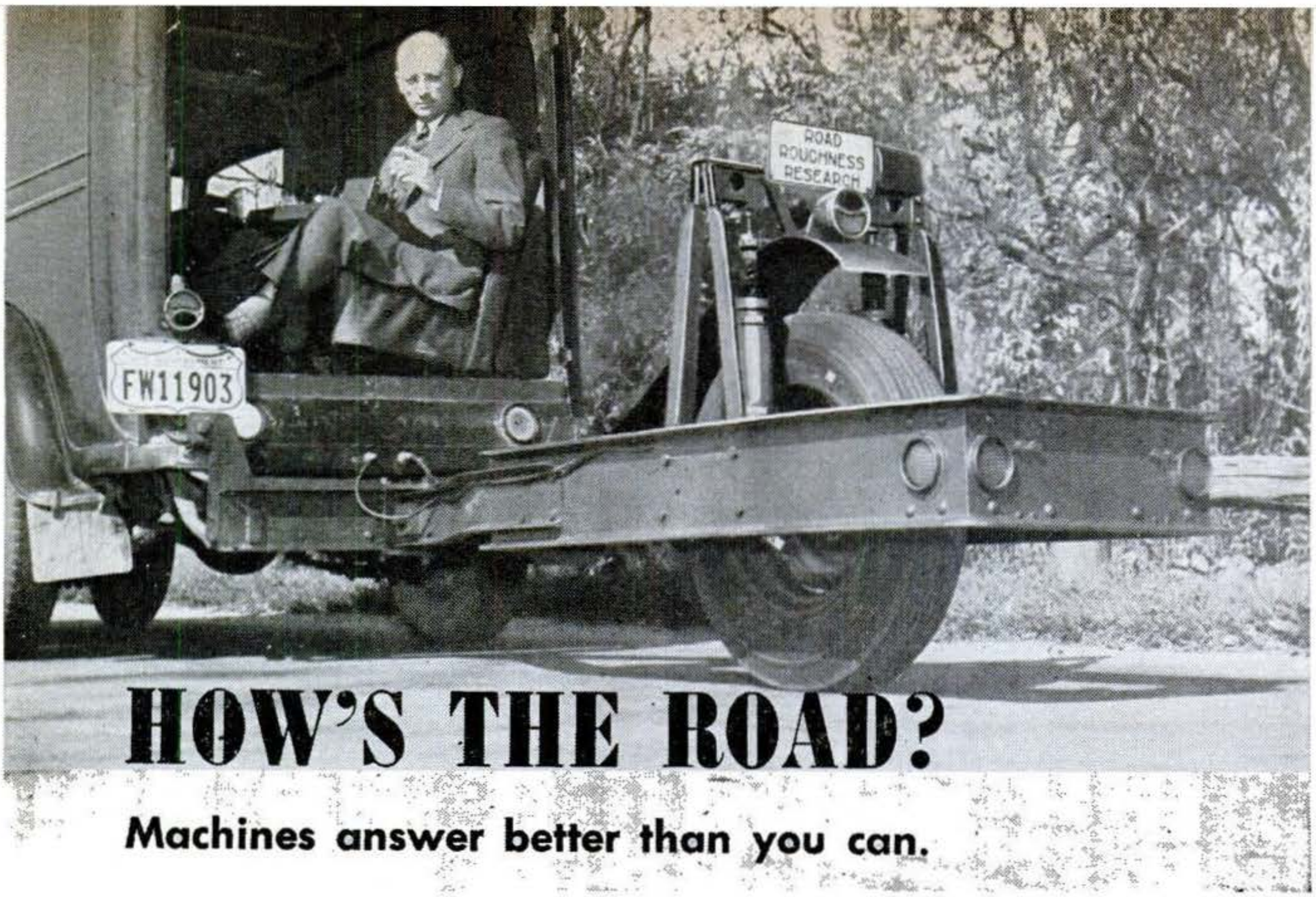

HOW'S THE ROAD?

Machines answer better than you can.

How Bumpy Is It? The trailer attachment above, one of the research instruments of the U. S. Public Roads Administration, measures the number and intensity of bumps per mile. By comparing a reading with previous figures, experts can estimate when a road will need repairs.

How Much Will It Take? Another PRA unit, below, is a 25-ton trailer that can be hoisted by a hydraulic jack to concentrate its weight on one spot. A dial tells, in thousandths of an inch, how much the road settles under the strain, thus measuring its load-bearing capacity.

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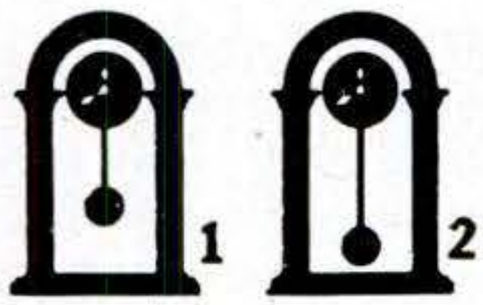
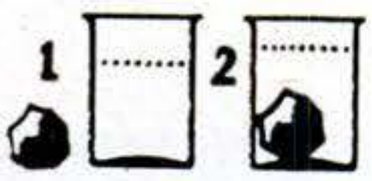
Push-Button School

Can you answer these?
(Answers on page 78)



Which of these clocks will tick faster?

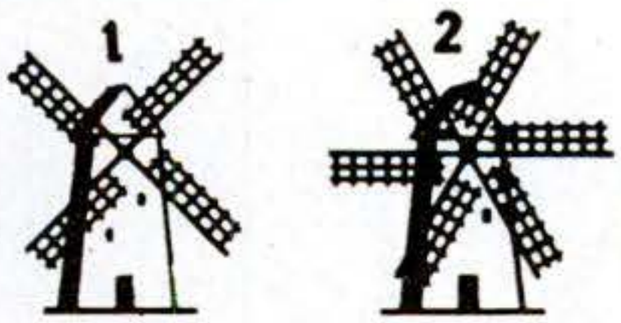
MC 11



1—More
2—Less
3—The same

If the rock and tank of water together in picture 1 weigh 100 pounds, what will they weigh in picture 2?

MC 13



Which windmill will do more work?

MC 24

This is the signal for

1. K
2. R
3. answering
4. P

Semaphore Signal—28

DON'T worry needlessly when Johnny says: "Gee, Pop, I just can't be late for school this morning—we're having a science test!" His school may have installed an Automatic Rater, a Navy-developed device that does away with many tedious written examinations, gives bonuses for speed, and makes taking tests as much fun as playing a pinball machine.

The possibilities of the Automatic Rater are just beginning to be explored. One was shown to science teachers at the recent meeting of the American Association for the Advancement of Science. It can be used to test a person's knowledge of any subject, and because it is a game of skill—well, other possibilities are obvious.

A valuable feature is that it gives the correct answer with each question, thus instructing as it tests. The competition it offers makes the machine popular, and it is compact enough to be placed in recreation halls or where students gather.

This is how it works:

When the operator presses the starter

The four question cards at the left are samples of those used in the Automatic Rater, the operating panel of which is pictured at the top of the page. The cards carry the correct answer in the upper right-hand corner, but the answers on these samples have been removed to show the cards as they first appear to a person using the machine.

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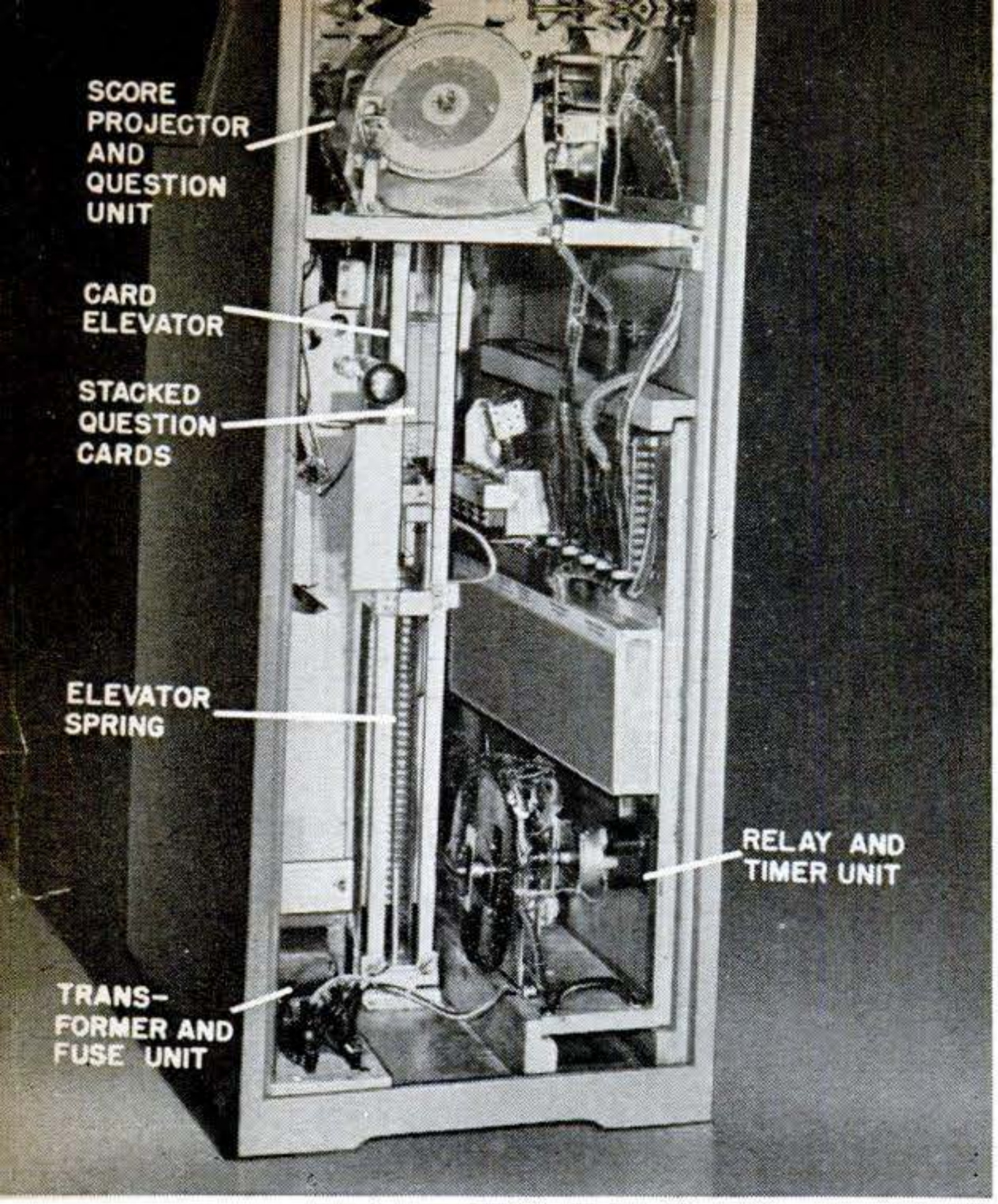


A rear view of the Automatic Rater shows the complex electromechanical arrangement required to display the cards, time the process and keep score.

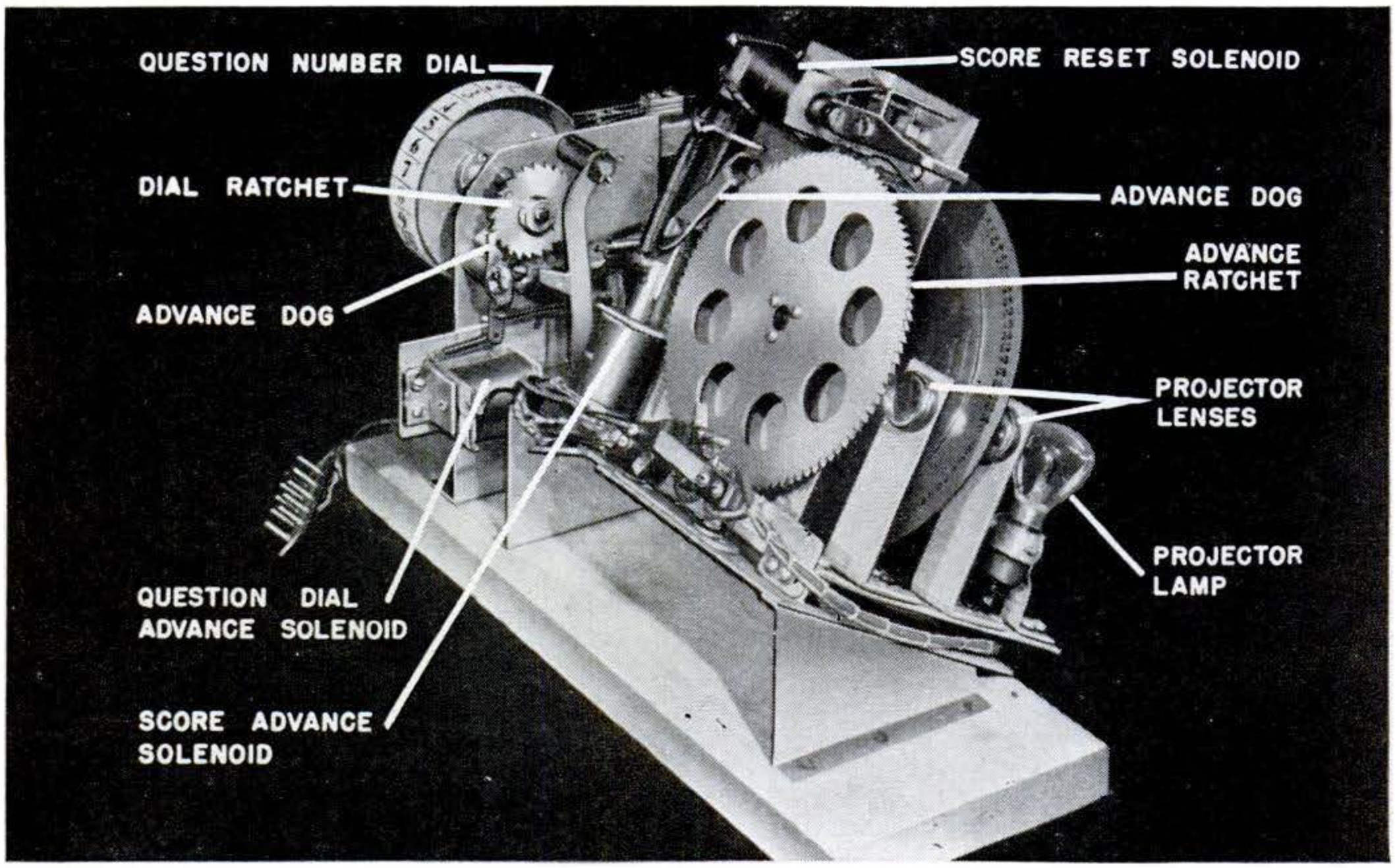
button, a multiple-type question card appears in a box at the upper left of the bottom panel. Four seconds are given to read the question. The student then has 20 seconds (ticked off by a line of dots running across the panel) to press the button on top of the upper panel corresponding to the answer he considers correct. Below the answer numbers are two apertures, one on the left that keeps track of the number of questions, and one at the right that totals the score. At the bottom left of the upper panel a green light flashes if the answer is correct; if the answer is wrong, a red light flashes at the right.

The question card is then shifted to another slot above the starter button, and the student sees the correct answer printed on it. Then the starter button is pressed, another question card appears, and we're off again.

About 1,000 cards on a variety of subjects are available now. To withstand the wear and tear of constant use, they are dipped in a plastic solution. The machine will take 650 cards at a time, but a reset button must be pressed after 10 cards have been run consecutively. END

Below is the numbering and scoring mechanism. The projector lamp shines through number perforations in the score disk to show the user his total.

ANSWERS: Reading from top to bottom, the correct answers for the cards on the preceding page are: No. 1, No. 3, No. 2 and No. 4.



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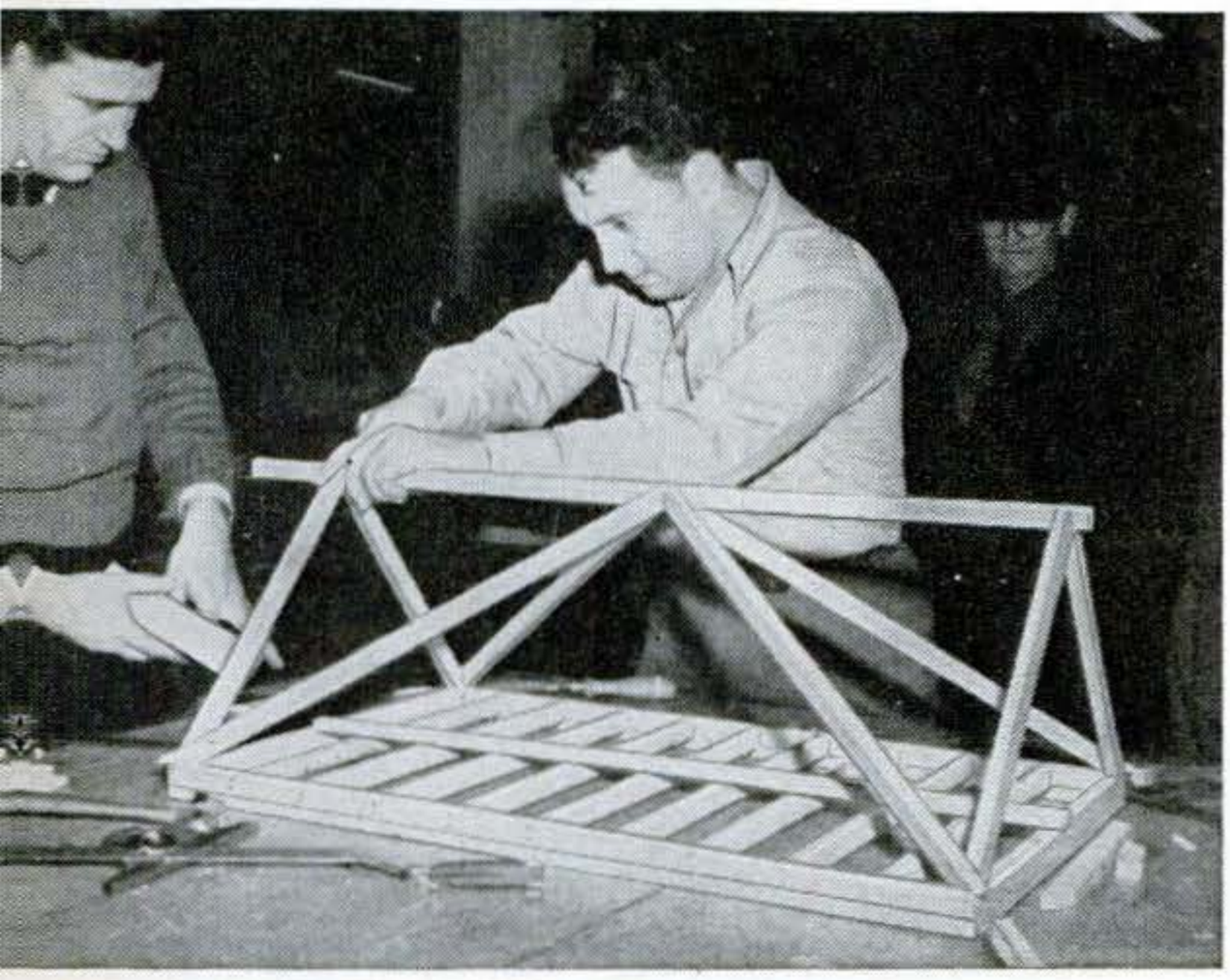
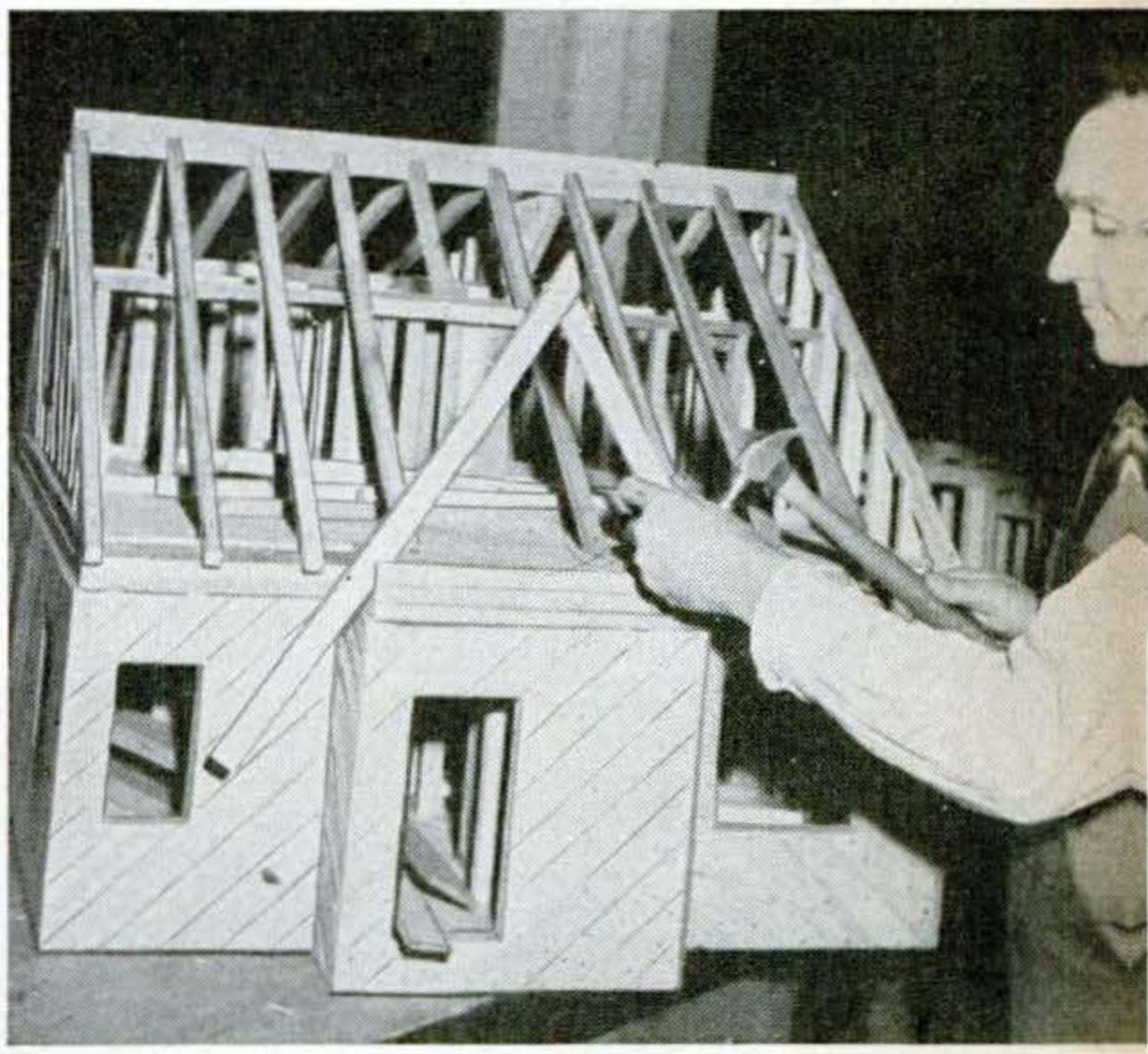
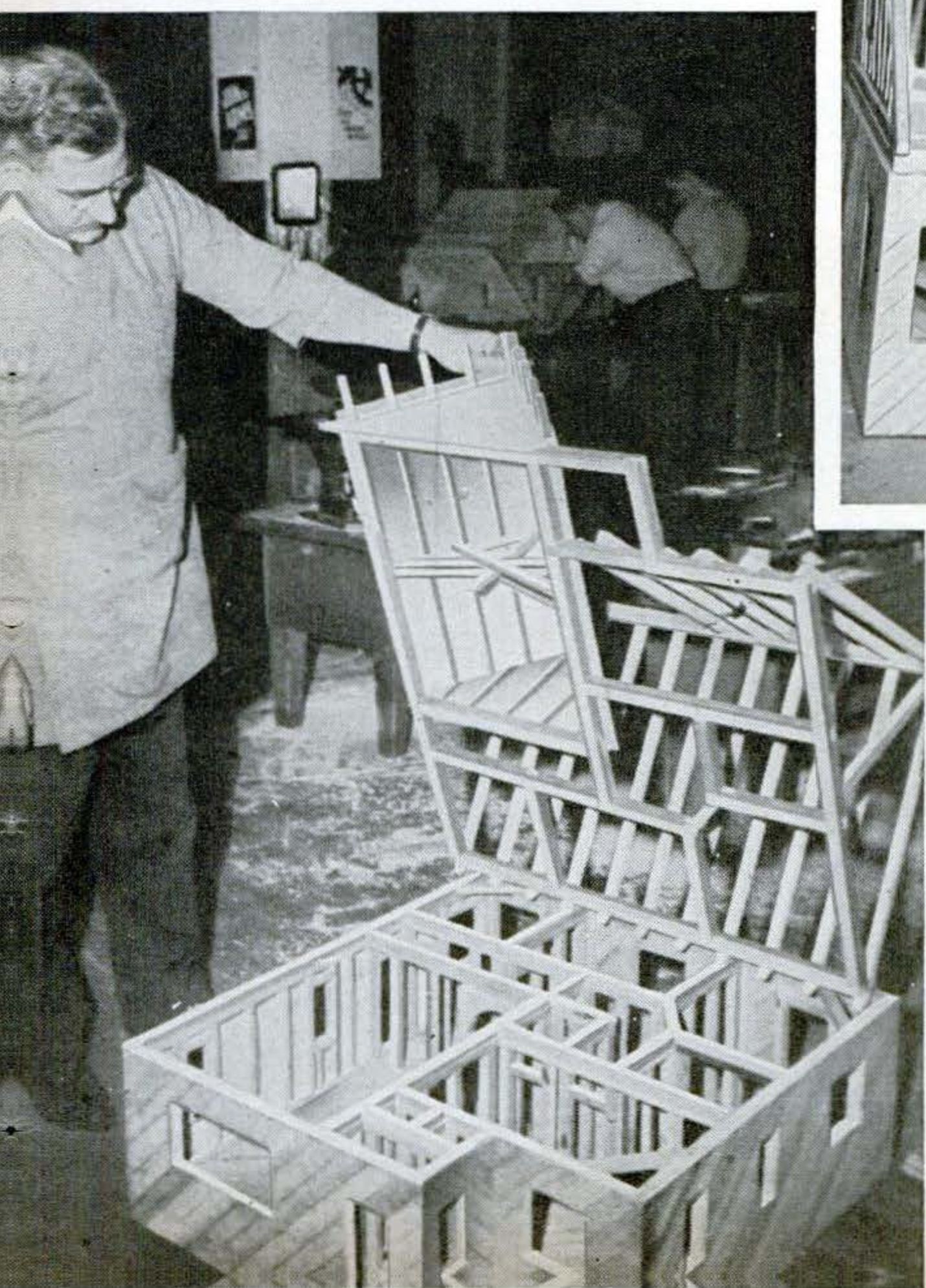
Models House Dreams



THE best way to make dreams come true is to work at them. And that is what a group of Detroit men are doing in a big woodworking shop of Cass Technical High School—building small models of the homes they hope some day to construct and live in.

These unique classes are held at night, under the direction of a master carpenter who sees to it that the men learn house construction from the ground up.





Upper left: These two students are "top" men, specializing in roofs—building them and tearing them down again. They hope to become experts in this kind of work.

Above: This student, a carpenter by trade, is learning things he can't pick up on the job. All major problems of building a full-size house are encountered.

Left: Removable roof enables students to finish interiors later. Materials are cut twice the scale in thickness because some of the small pieces would otherwise be too flimsy. The houses represent all types of construction, many designed by students.

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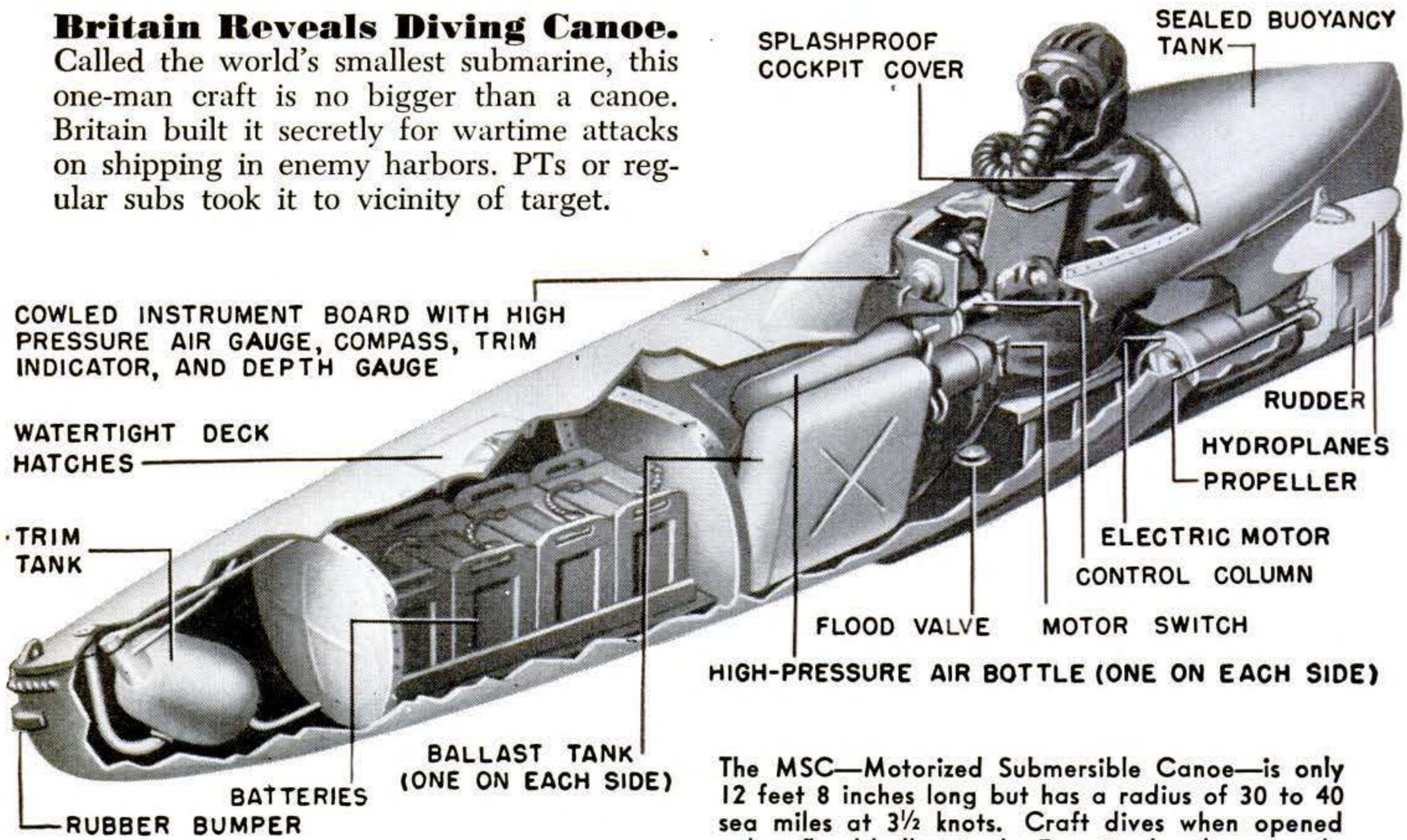
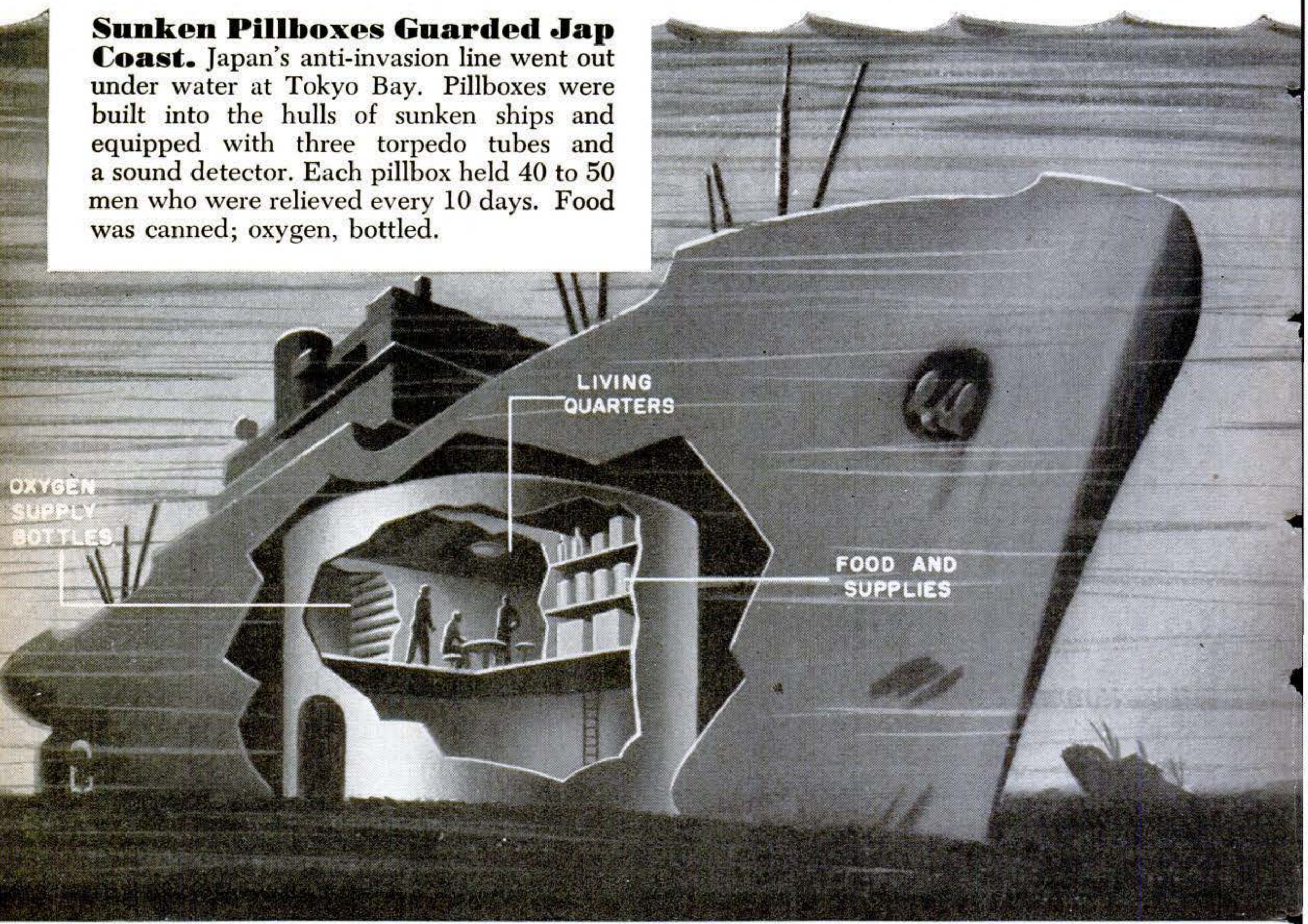
Britain Reveals Diving Canoe. Called the world's smallest submarine, this one-man craft is no bigger than a canoe. Britain built it secretly for wartime attacks on shipping in enemy harbors. PTs or regular subs took it to vicinity of target.



The MSC—Motorized Submersible Canoe—is only 12 feet 8 inches long but has a radius of 30 to 40 sea miles at 3½ knots. Craft dives when opened valves flood ballast tanks. For attacks, always made at night, pilot was strapped in for 10 hours or more.

Sunken Pillboxes Guarded Jap Coast. Japan's anti-invasion line went out under water at Tokyo Bay. Pillboxes were built into the hulls of sunken ships and equipped with three torpedo tubes and a sound detector. Each pillbox held 40 to 50 men who were relieved every 10 days. Food was canned; oxygen, bottled.



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Mountains Grow Up. Thanks to a supersensitive altimeter, many of Colorado's mountains are getting their heights lifted. Mt. Grizzly, for example, formerly rated at 13,000 plus, is now figured at 14,004 feet. And Mt. Harvard's gain of 18 feet—to 14,417—is just enough to slip it into fourth place among U. S. peaks.

The altimeter is shown above with a mountaineering party from the University of Colorado. Made by Wallace & Tiernan, the 2½-lb. instrument is sensitive to one part in 8,000, accurate to one in 1,000. An evacuated capsule of beryllium copper gauges air pressure, and an almost frictionless mechanism records it on a dial.

Reeling to Safety. Fire threaten? Strap on the belt, climb out the hotel window, and—as Detroit inventor Irving Bassett shows—a steel tape reels out automatically to drop you safely to the ground.

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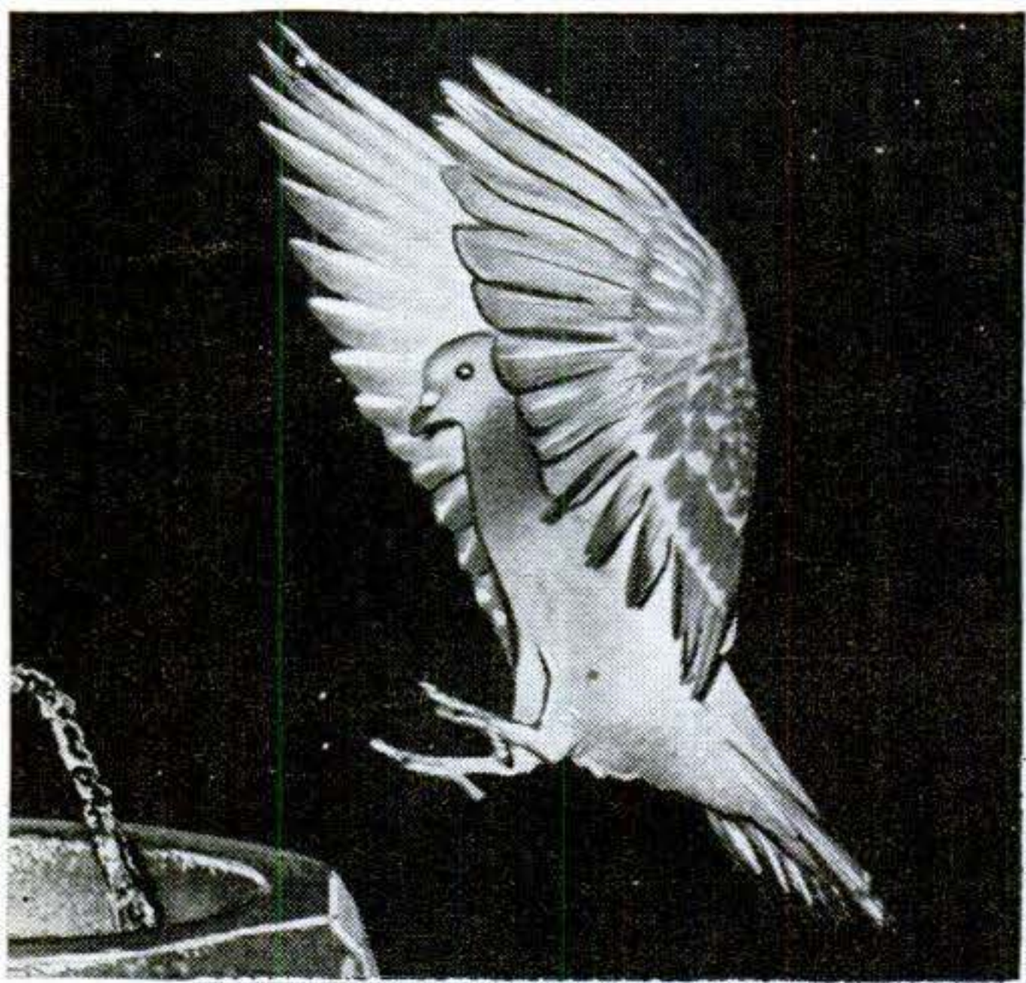
Pocket Radio Transmits and Receives. The tiny Tele-Radio at right, British made, is both a transmitter and receiver. The set, being shown by inventor Michael Kasia, fits in top pocket, power pack in bottom. Aerial is sewn into jacket lining.

Navy Designs Streamlined Multiflash. Lighter and faster than commercial types, the Navy's new multiple photoflash unit weighs only 11½ lb. but delivers 1,500 flashes without a battery change. With an alternate battery the capacity is 4,000 flashes. Each 1/10,000-second flash gives as much light as a medium flash bulb. Photo below shows how flash catches a bird in midflight. At bottom is the 2,000-volt battery pack, 4 by 6 by 10 inches; its coaxial cable and the lamp are in place on camera.



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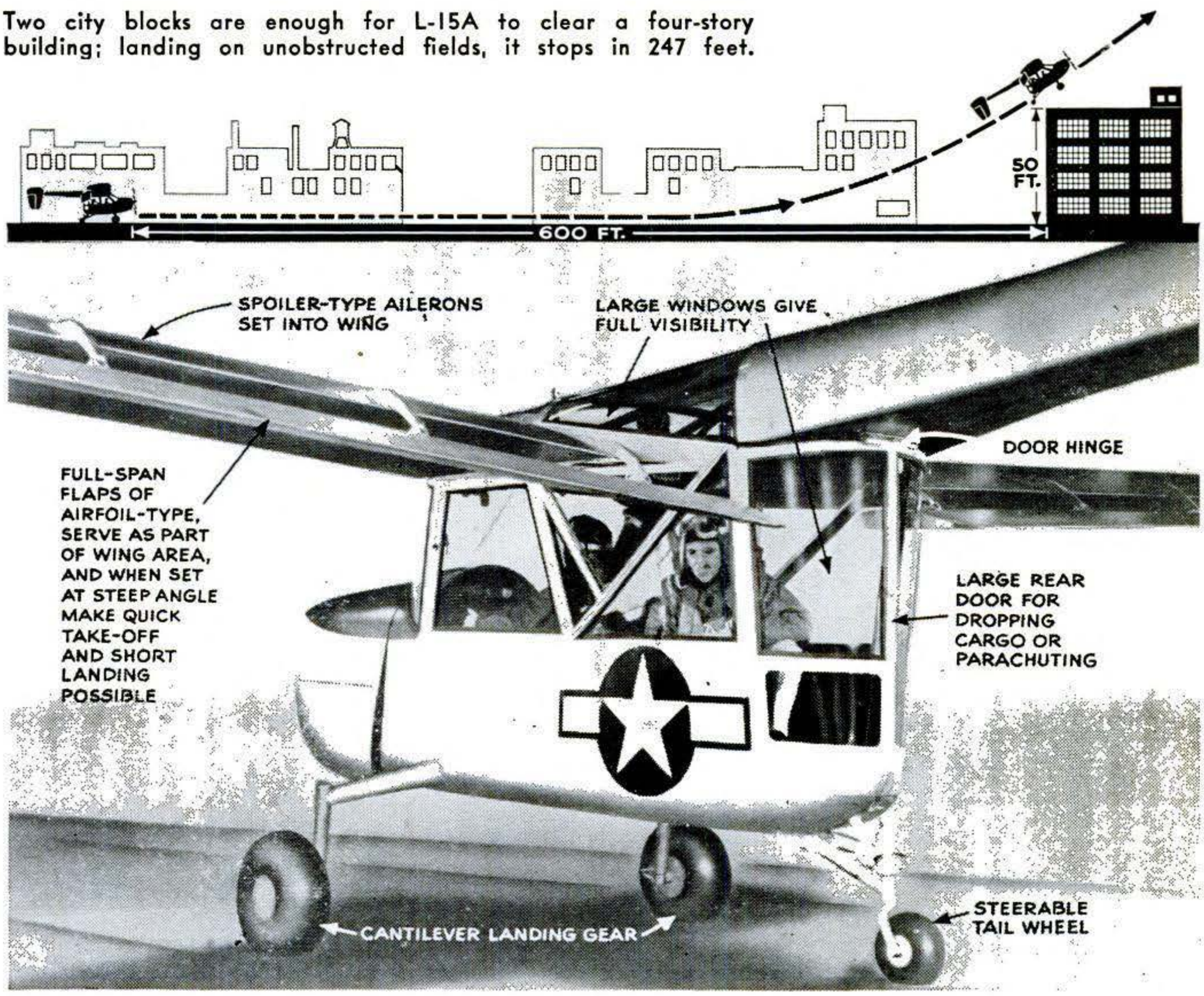
Underslung gondola, giving all-around visibility, makes the L-15A ideal for observation. Its reversible rear seat can be replaced by a camera.

Grasshopper's Eyes Widened

VISIBILITY and versatility are featured in a new "grasshopper" plane, the L-15A, designed by Boeing for use by the Army Ground Forces. Increasing its ability to get in and out of small areas, its wheels can be quickly replaced by skis, or floats can be installed in place of the landing gear.

An external fuel tank suspended under the gondola increases its range from 2½ to 5½ hours. Carrying pilot and observer, this new member of the "flying jeep" family will climb 628 feet in one minute, has a service ceiling of 16,400 feet, and will fly at speeds ranging from less than 50 m.p.h. to a maximum of 112 m.p.h. It can also be towed, glider fashion.

Two city blocks are enough for L-15A to clear a four-story building; landing on unobstructed fields, it stops in 247 feet.



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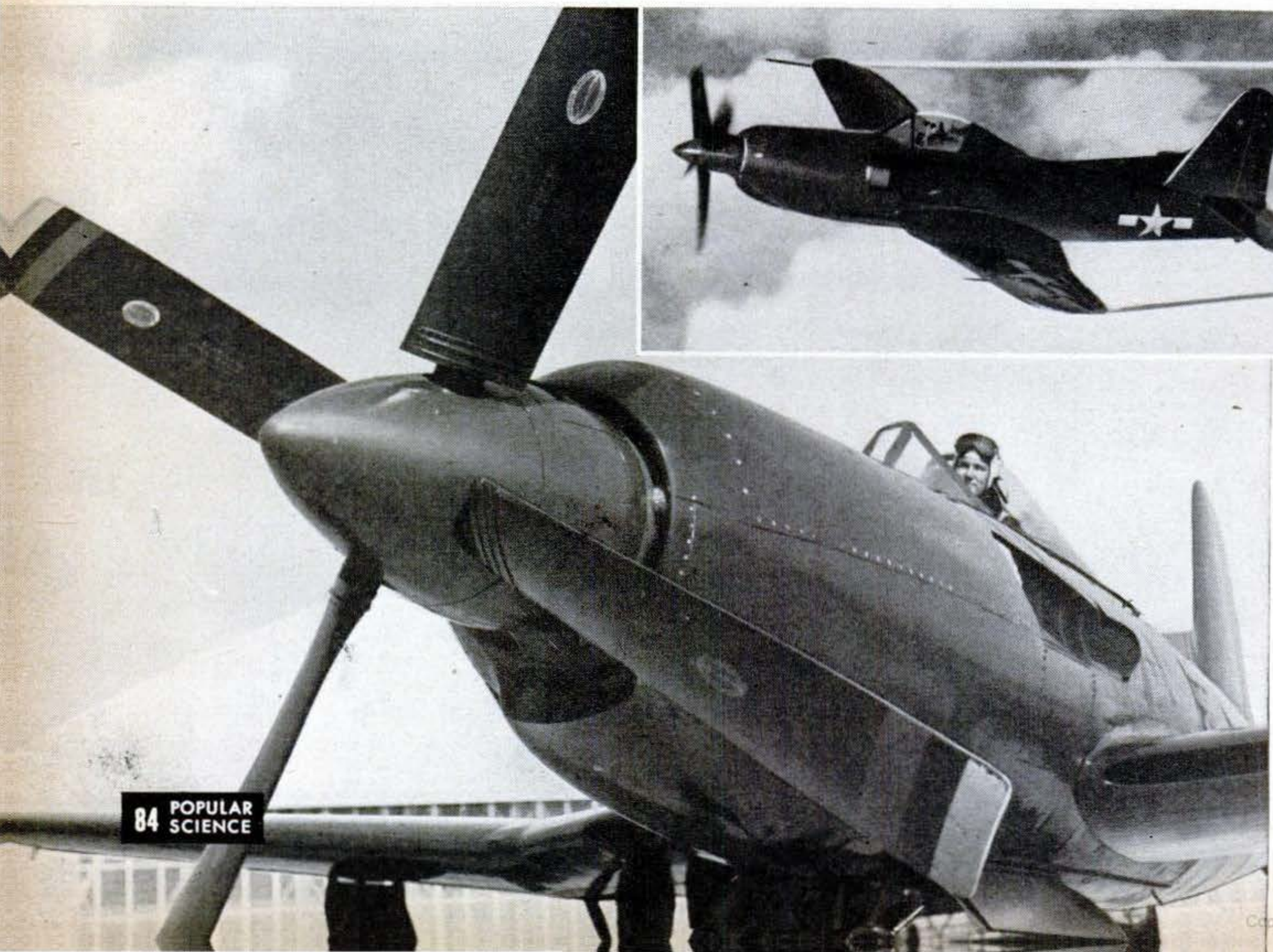
WHAT'S NEW in AVIATION

BRITAIN BUILDS JET "WING." The Armstrong Whitworth AW-52, shown awaiting its test flights, is Britain's first jet-propelled flying wing. Constructed after three years of experiments with a half-size glider model, the craft is powered by two Rolls-Royce Derwent turbo-jets, whose twin exhaust stacks can be seen aft of the canopy. It carries two persons, and its swept-back wing measures about 90 feet between the two tall wing-tip rudders.

NAVY TESTS ITS HOTTER FIREBALL. The Ryan XF2R-1, with a gas turbine prop-jet engine driving its propeller and a separate thermal jet unit aft, is a successor to the Navy's FR-1 Fireball, which has a piston-type engine plus a jet. The XF2R-1, said to outdo the original Fireball both in speed and rate of climb, is the first Navy plane of its type. The forward engine provides power through the propeller and also through its jet exhaust, which streams from troughs on either side of the fuselage just below the cockpit.



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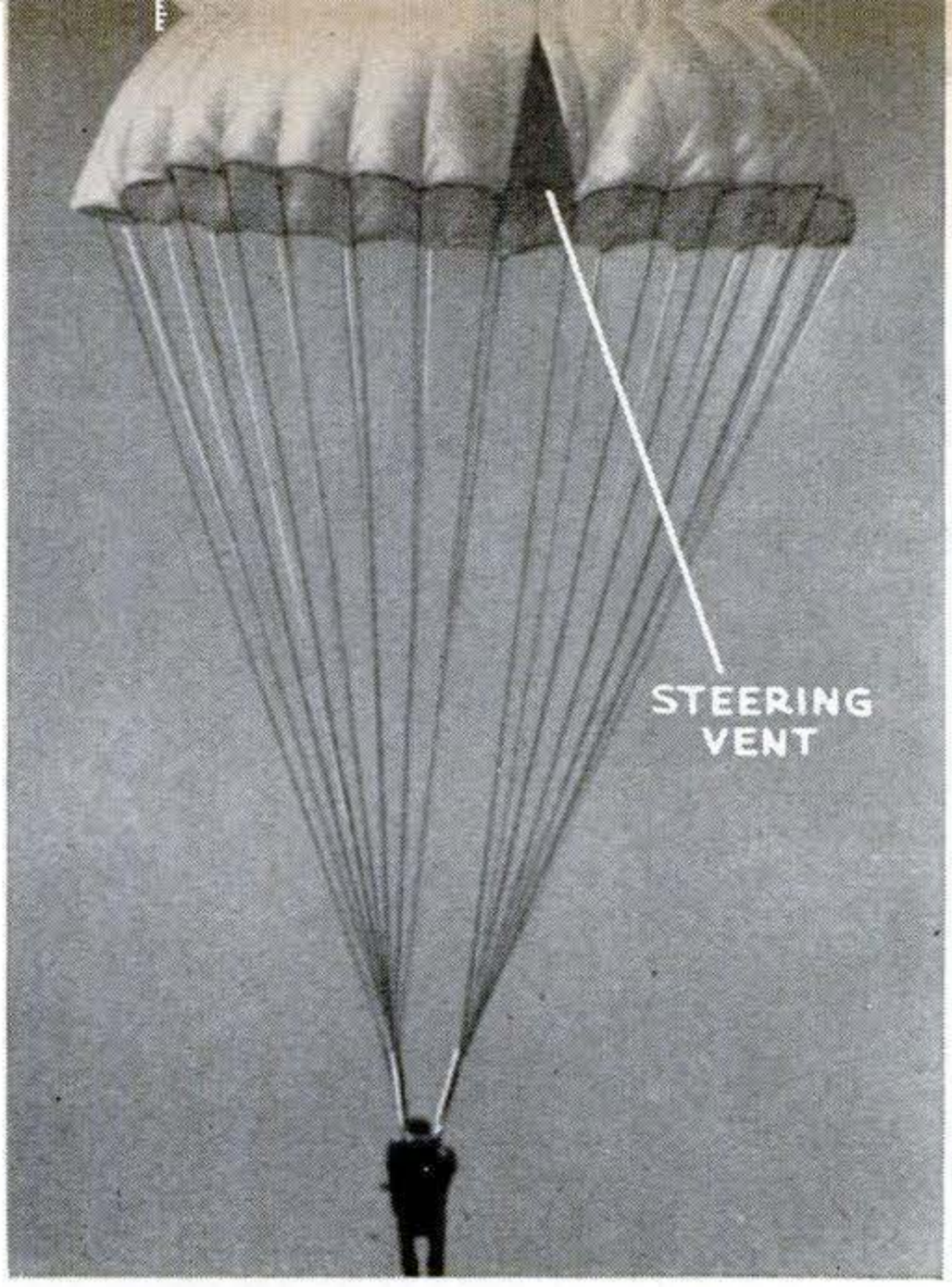
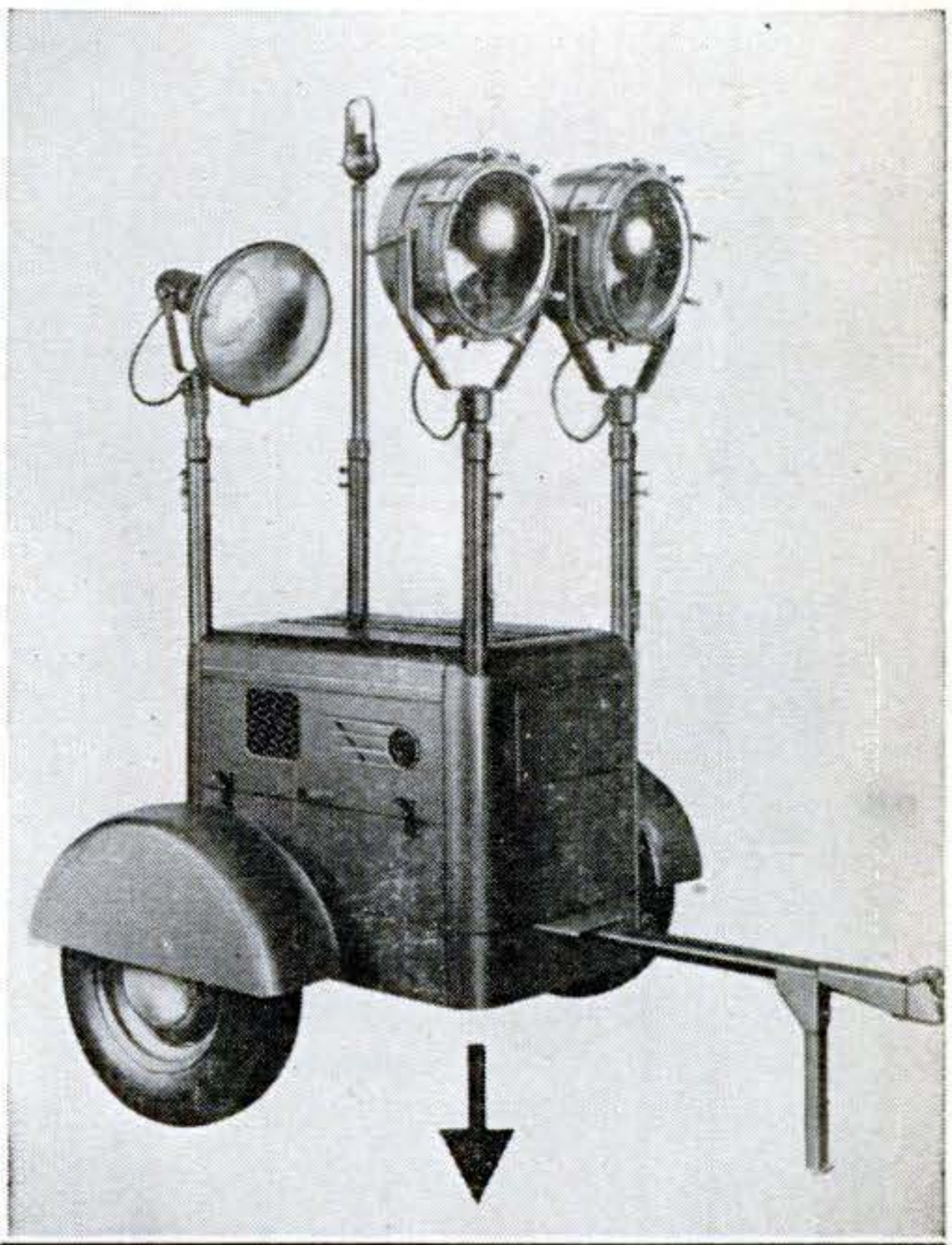
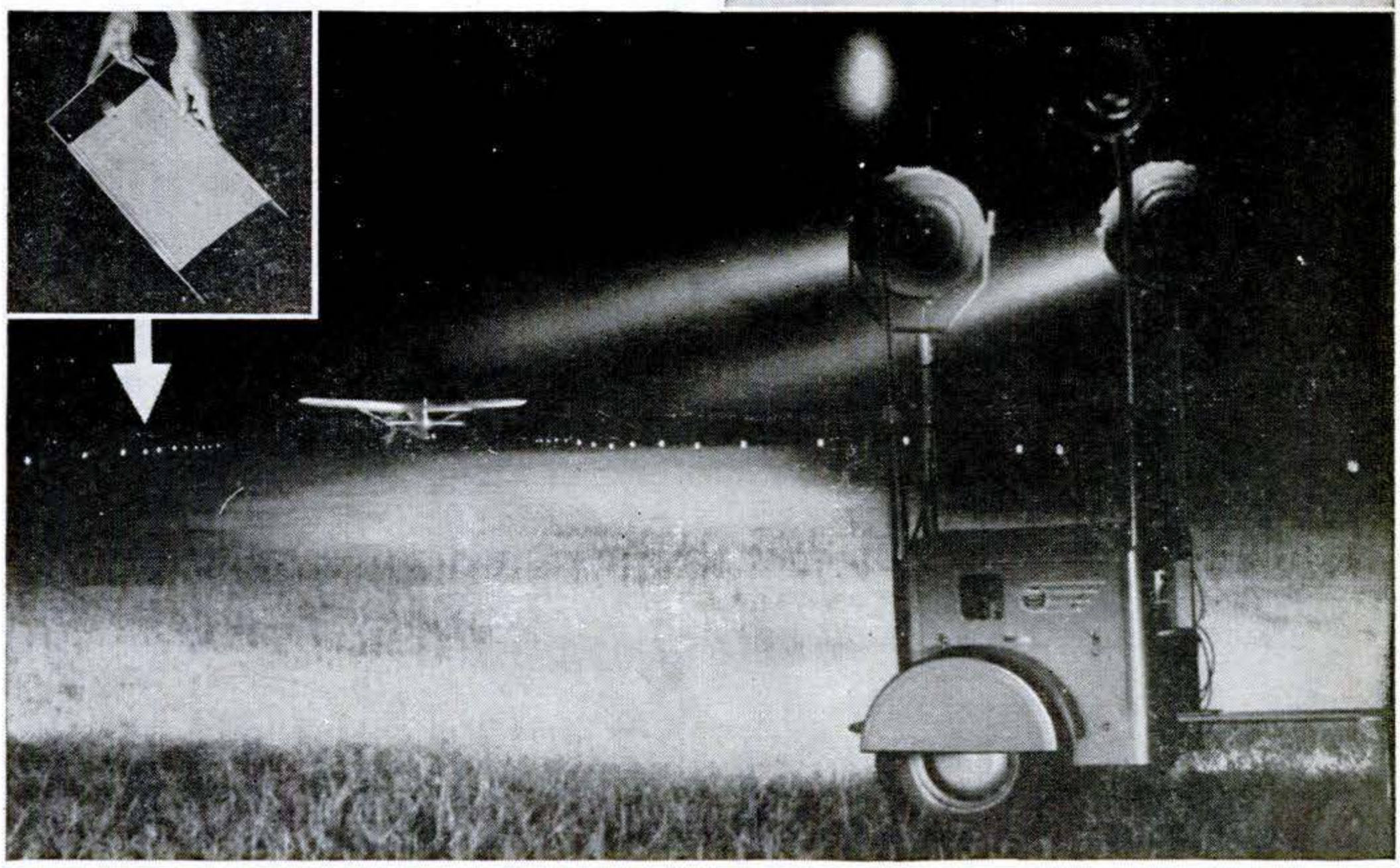


PARACHUTE IS STEERABLE. A wedge-shaped vent in the canopy of a new type of parachute, being service-tested by the Army, enables a jumper to control the direction in which he travels. The vent, directly to the rear of the jumper, makes the front panels of the 'chute act as a sail. Risers are connected to the edges of the vent, and by pulling them the jumper can guide the 'chute to right or left. It is also possible to swing it around so that he faces into the wind.



LIGHTING SMALL AIRPORTS. With reflecting markers outlining the boundaries of an airstrip, the Onan Floodlighter, shown below in a night test, provides lighting facilities for small or intermediate airports that cannot afford underground wiring systems or that lack an adequate source of commercial power. The lighting unit itself, at the right, is a mobile, gasoline-powered generator with three 1,000-watt floodlights; when not used for illumination, it can supply electric power for repair equipment. One of the reflecting markers is shown in the inset below.



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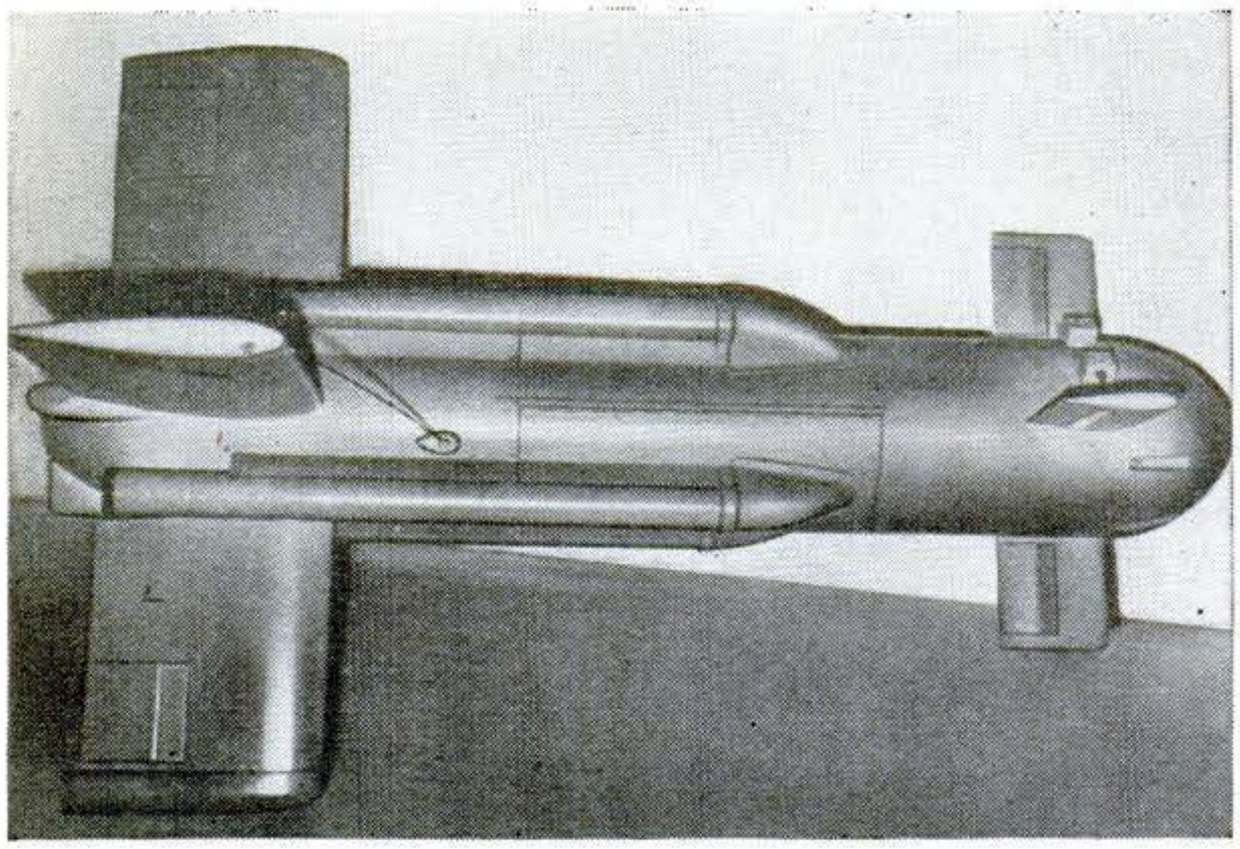
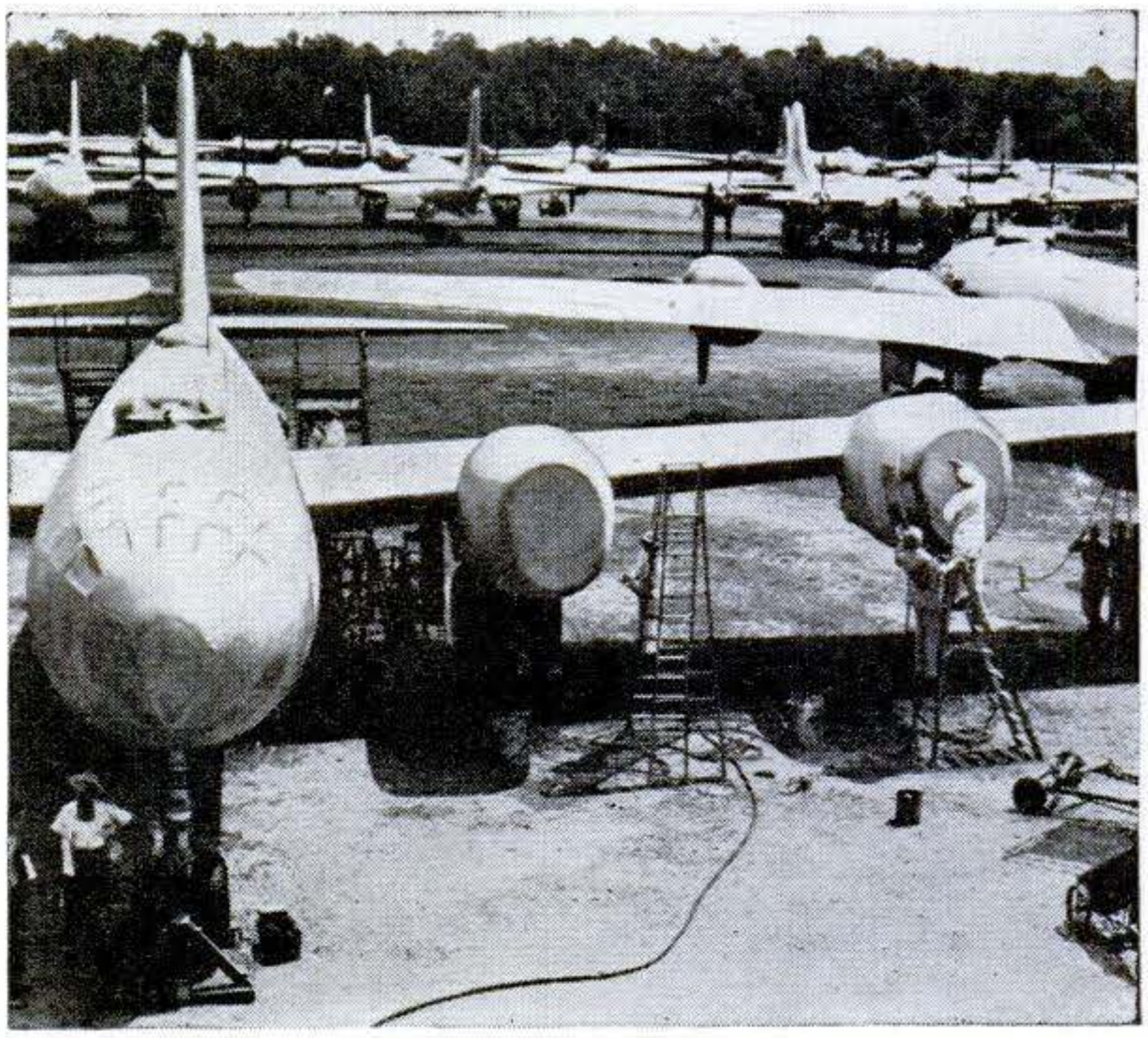
WHAT'S NEW in AVIATION



SEAGOING TRANSPORTS. Six Navy R4D transports, like those shown above, will be launched from the 600-foot flight deck of an aircraft carrier with the Navy's 1947 Antarctic Expedition. The 12-ton planes will use jet-assisted take-off units to get aloft near Little America and will fly to a landing strip previously prepared there. First transports ever to leave a carrier's deck, they will be used for long-range photographic and reconnaissance missions to gather geographical data for the expedition.

ROCKET BUILT FOR WARSHIPS. The stub-winged rocket above is Little Joe, one of the new guided missiles being developed by the Navy for special uses. Little Joe is a short-range antiaircraft rocket designed to be launched from shipboard catapults. It is radio-controlled and is powered with solid fuel.



B-29S GET COCOONS. Coated with five layers of special plastic in a new preservation process, the B-29s at the right are among 1,500 of the big planes being stored by the AAF for possible future use. After removal of engines and equipment, the five coats are sprayed on, each one a different color to insure complete coverage. (Open spaces are bridged with synthetic cobwebs before being sprayed.) The final coat is aluminum-colored to reflect sun and keep planes cool. The process is expected to protect planes for 10 years.

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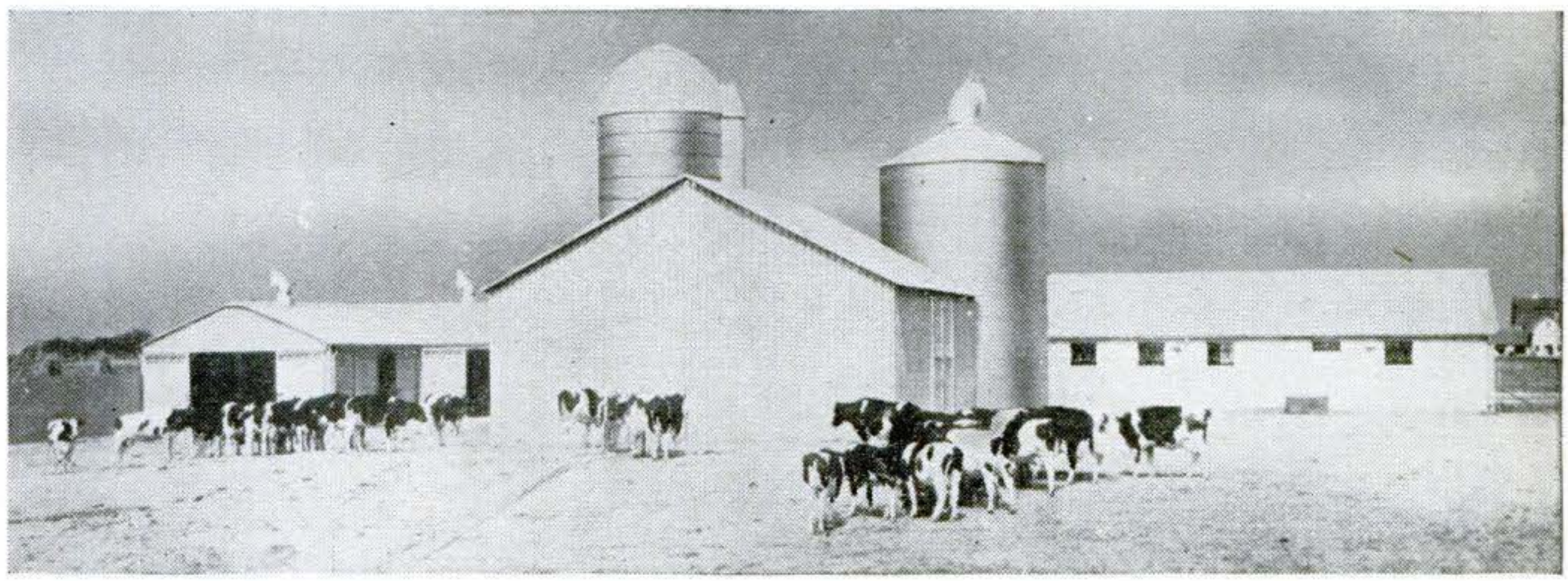
SCIENCE GOES TO THE FARM

Strange-looking antennas, like this one being set up over the L. E. Beek ranch in Colorado, now give telephone service to isolated farms. The conversations travel by radio to the nearest switchboard.

A technician inspects the transmitter that connects the Beek ranch with the Cheyenne Wells, Colo., exchange. The 10-watt, 44-50 megacycle set is in the basement; upstairs only a standard handset is seen.

THE farmer won't be left out of science's plans for an easier postwar life. New machines, methods and services soon to be available promise less work and more profit to the men who plow the fields—plus city comforts for the old farmhouse.

This spring, equipment manufacturers are displaying many improved implements. Some, like the new pint-size tractors, are specialized adaptations of existing machines for the small or extra-large farm, while others are completely new devices that mech-



Consolidated barns that centralize all farming work in one large building are advocated by agricultural engineers. The barn above is constructed of steel, assembled and welded right at the building site.

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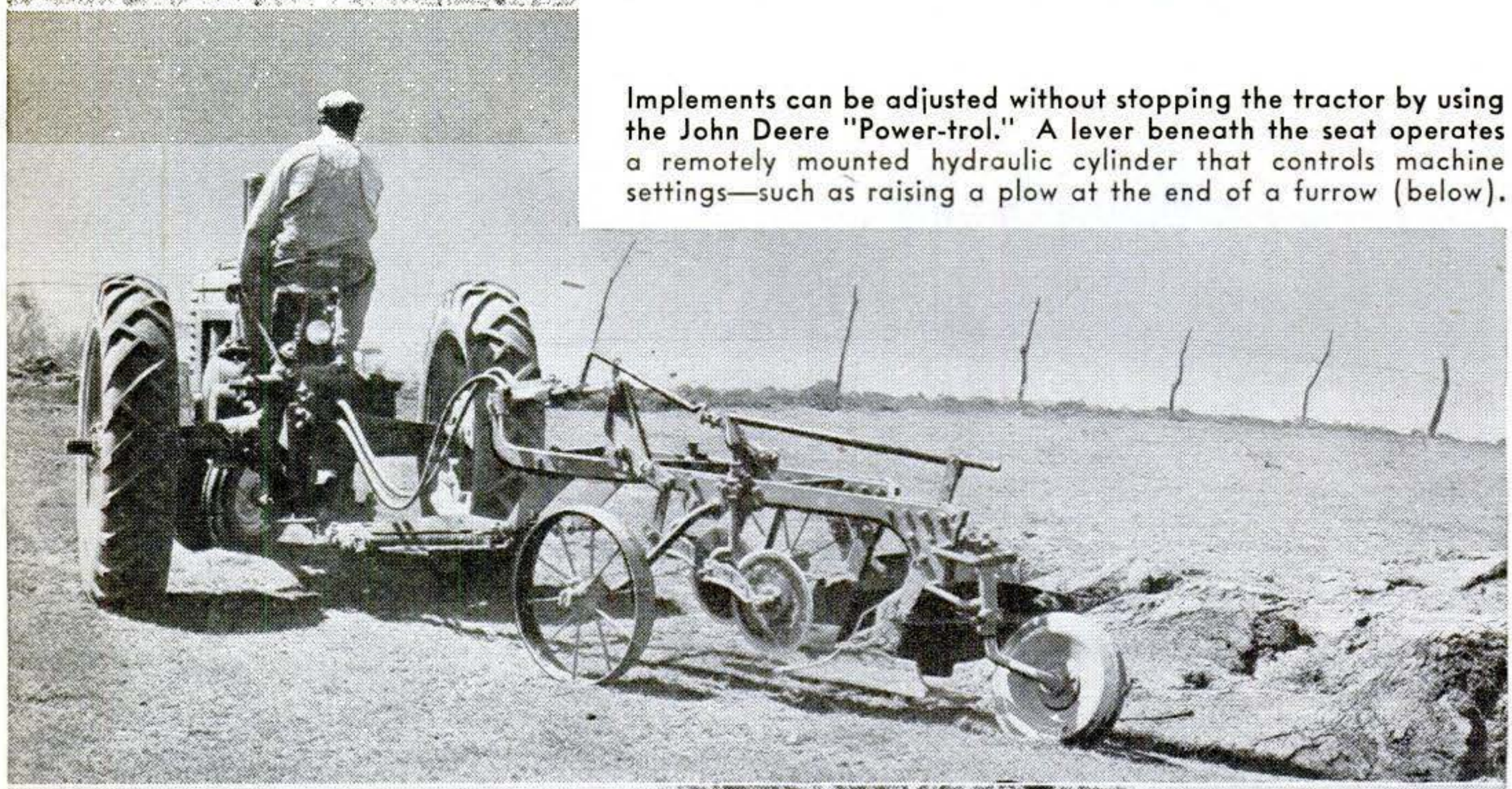
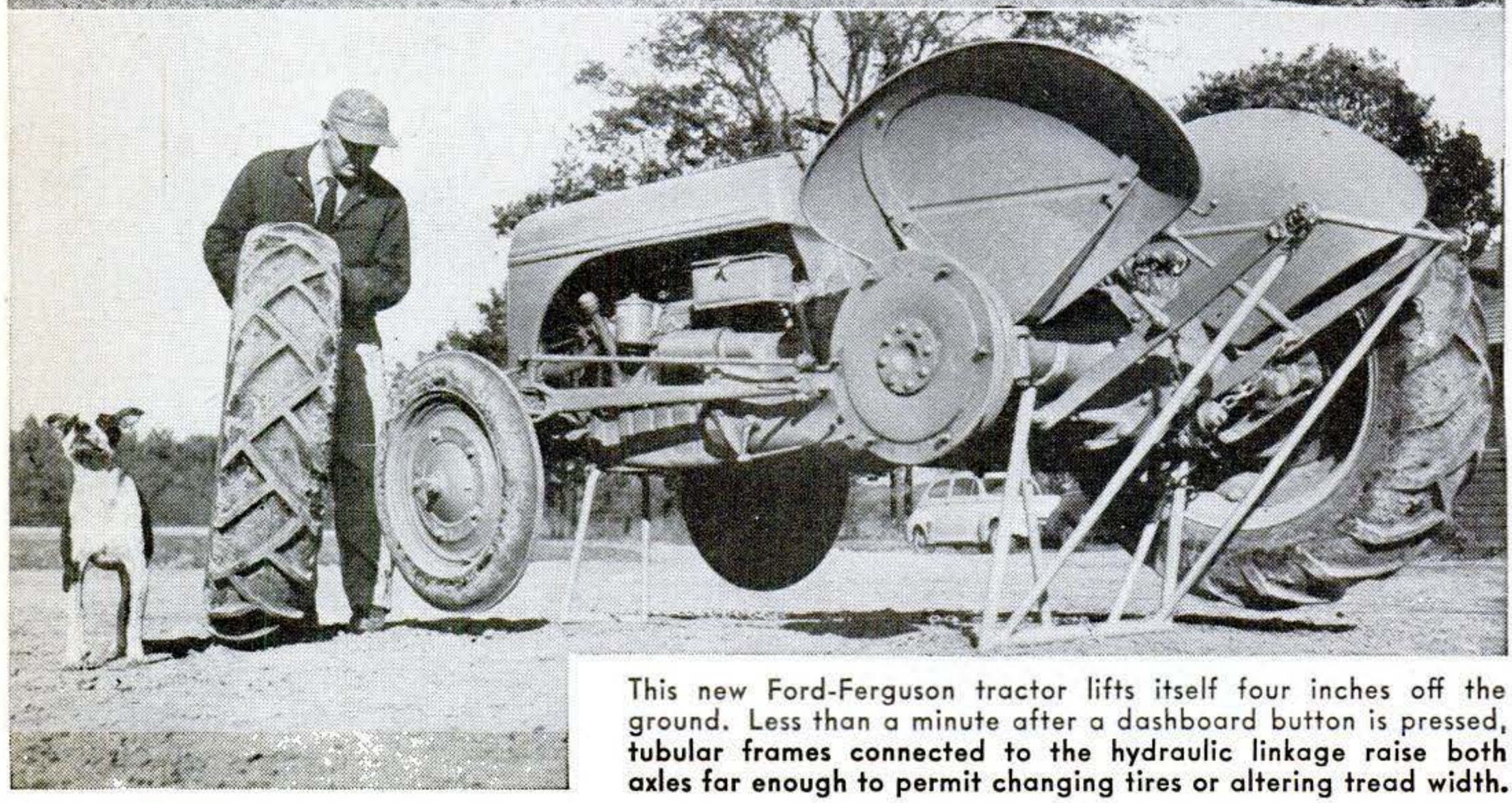
With this new baler, one man with a tractor can handle an entire field of hay. The machine turns out neat rolled bales, spirally wrapped with ordinary binder twine. The Allis-Chalmers model shown above is one of several makes soon to be available.



Implements can be adjusted without stopping the tractor by using the John Deere "Power-trol." A lever beneath the seat operates a remotely mounted hydraulic cylinder that controls machine settings—such as raising a plow at the end of a furrow (below).



This new Ford-Ferguson tractor lifts itself four inches off the ground. Less than a minute after a dashboard button is pressed, **tubular frames connected to the hydraulic linkage raise both axles far enough to permit changing tires or altering tread width.**

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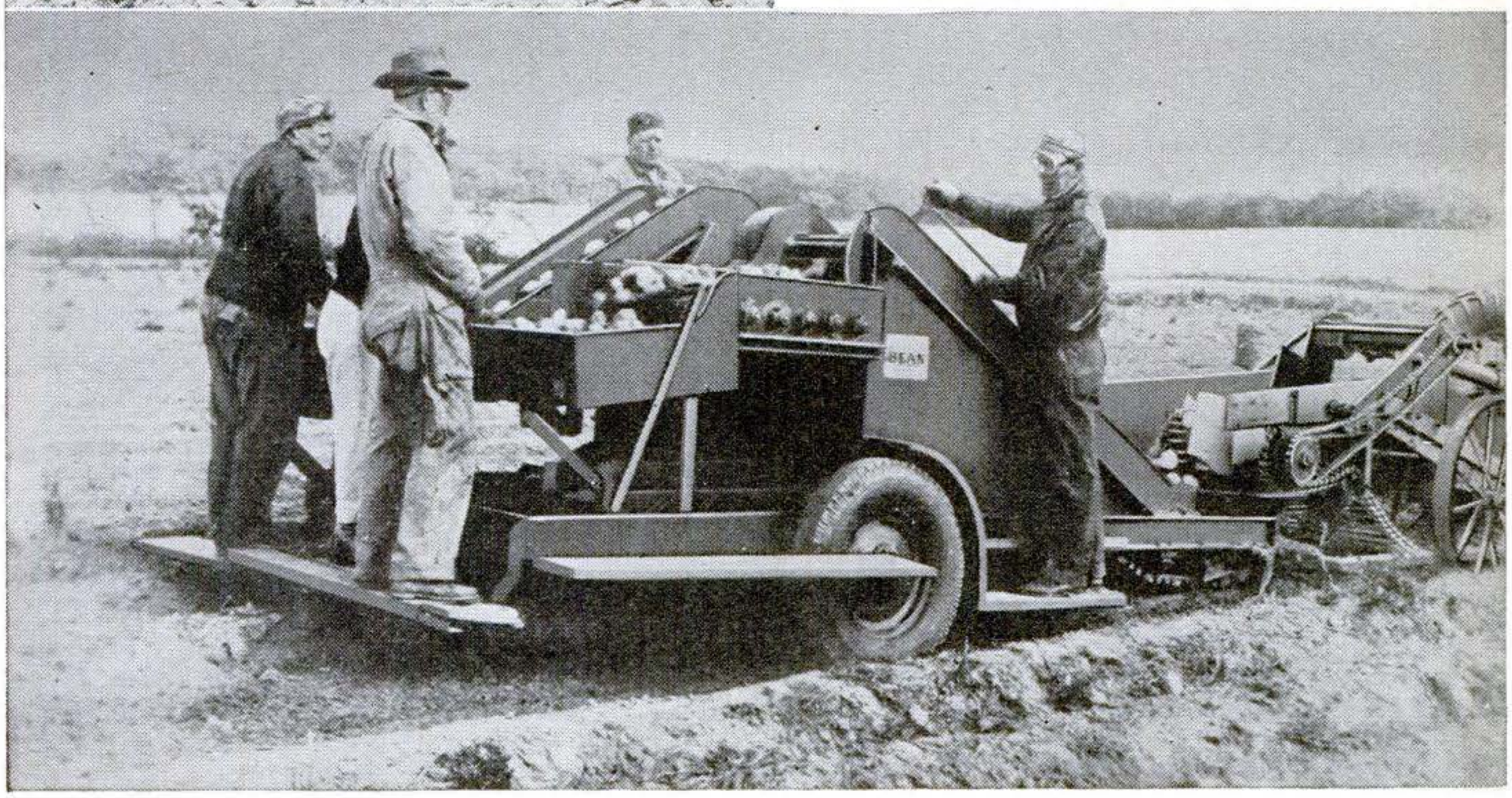
anize laborious, back-breaking hand jobs.

Even the looks of the farm may change radically. Instead of a variety of scattered buildings (10 is the Iowa average), there may be one large, centralized structure. It would be cheaper to build (end sections cost twice as much as the middle part of a building) and would save the farmer time and steps. Steel companies, urging the use of metal for such consolidated superbarns, even point out that war-trained welders may now be easier to hire than expert carpenters.

Nor is the farmhouse forgotten. Telephone service is being extended to the most remote places by radio links to the wire networks, or by superimposing telephone messages on rural power lines. And modern appliances such as the home freezers bring the food variety of a supermarket to the farm wife's kitchen.

With science rapidly making rural life so much more pleasant, the convenience-loving city dweller may soon want to desert his apartment-scarce, traffic-choked metropolis. It's becoming too uncomfortable. END

One of the many small tractors planned by manufacturers is the Model V, made by B. F. Avery & Sons Co. Designed for economical use on limited acreage, it is shown pulling a semimounted, two-furrow disk plow controlled by a guide rod.



The drudgery of hand-picking potatoes is eliminated with this harvester, which does the work of 15 hand laborers. Made by the John Bean Manufacturing Co., it removes vines, weeds, loose dirt and most stones, harvesting as much as 3,000 bushels a day. A crew of three or four is needed.

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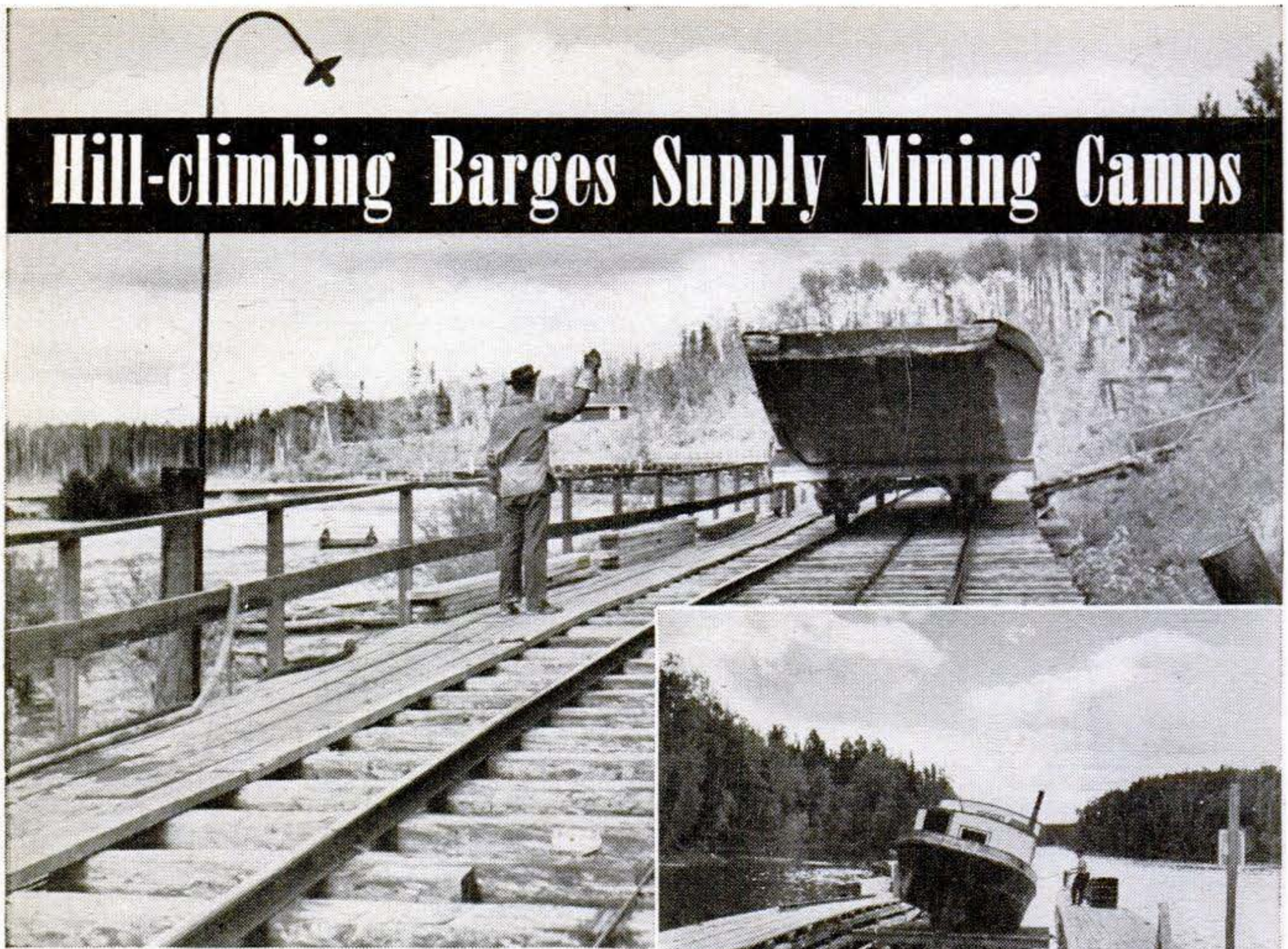
Hill-climbing Barges Supply Mining Camps

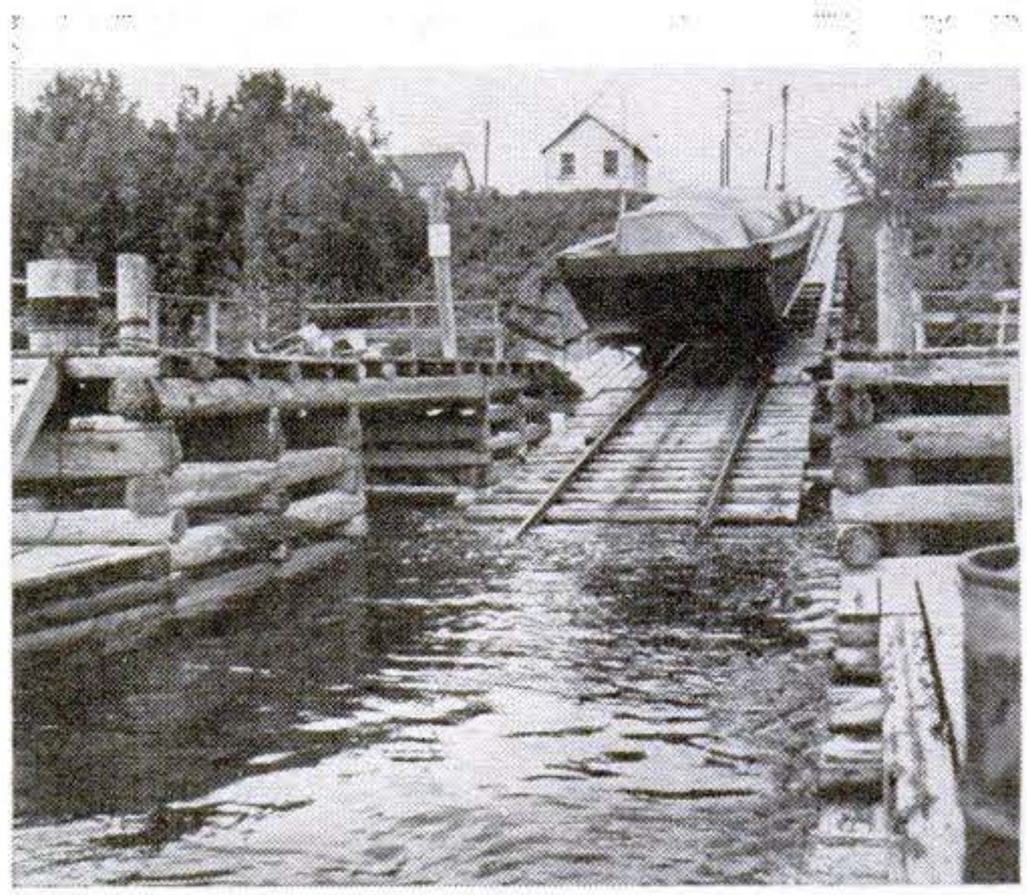


Sam's Portage is the longest of four on the route. Above, a hoistman signals to men at other end that this is the last scow of a "swing" to Red Lake.

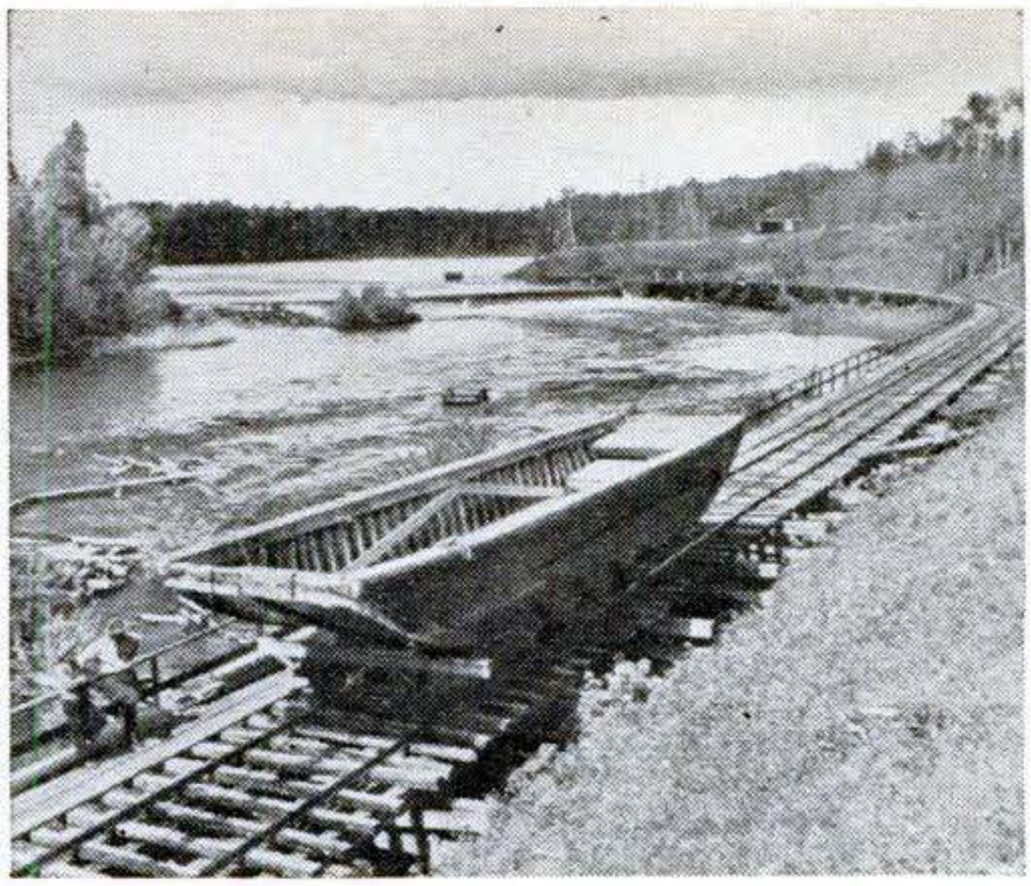
At right, a tugboat starts out of the water at Sam's Portage. The cradle is still under water. The charge for freight carried on scows is $20 a ton.

FROM the railroad at Hudson, Ont., to the rich gold mining district around Red Lake is only 180 miles, but mighty tough ones. There is no road; in winter only the most essential supplies can be taken in by tractor trains. Heavy mining gear must wait for the summer water route via Lac Seul and the Chukini River—and the Chukini is broken by rapids in four places.

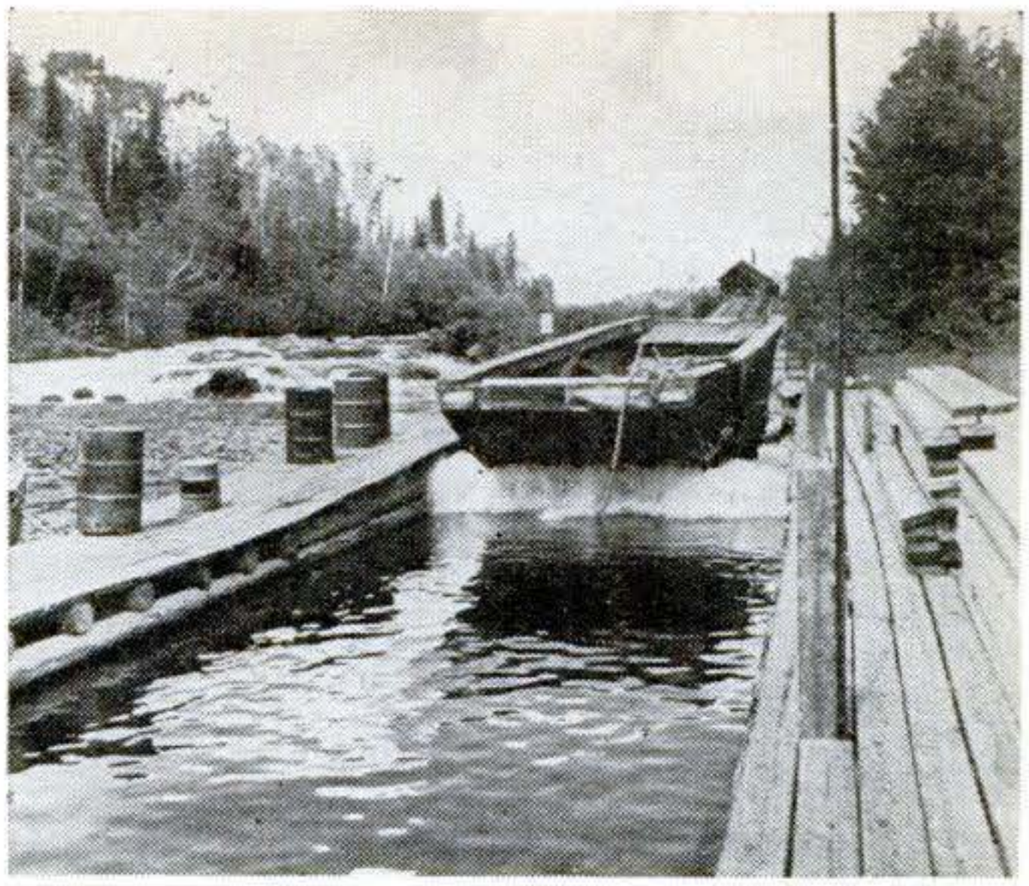
To short-circuit the white water, the traditional portage system is used—with modern mechanization. Multiwheeled cradles pick up scows and tugs at each portage and carry them overland on a cable-powered railway. Totaling only about a mile in length, the four portages take up six to eight hours of the normal 48-hour run. For perishables, the trip is cut to 36 hours by eliminating layovers. Crews—mostly ex-GIs—spend their winters in industry or prospecting, or else run the "cat" trains.



Hitched to a cable, scow and cradle climb out of the water at Ear Falls, first portage point. Building at top of hill is hoist house, containing the donkey engine that powers the cable. On second half of trip, car rolls down grade and cable acts as brake.

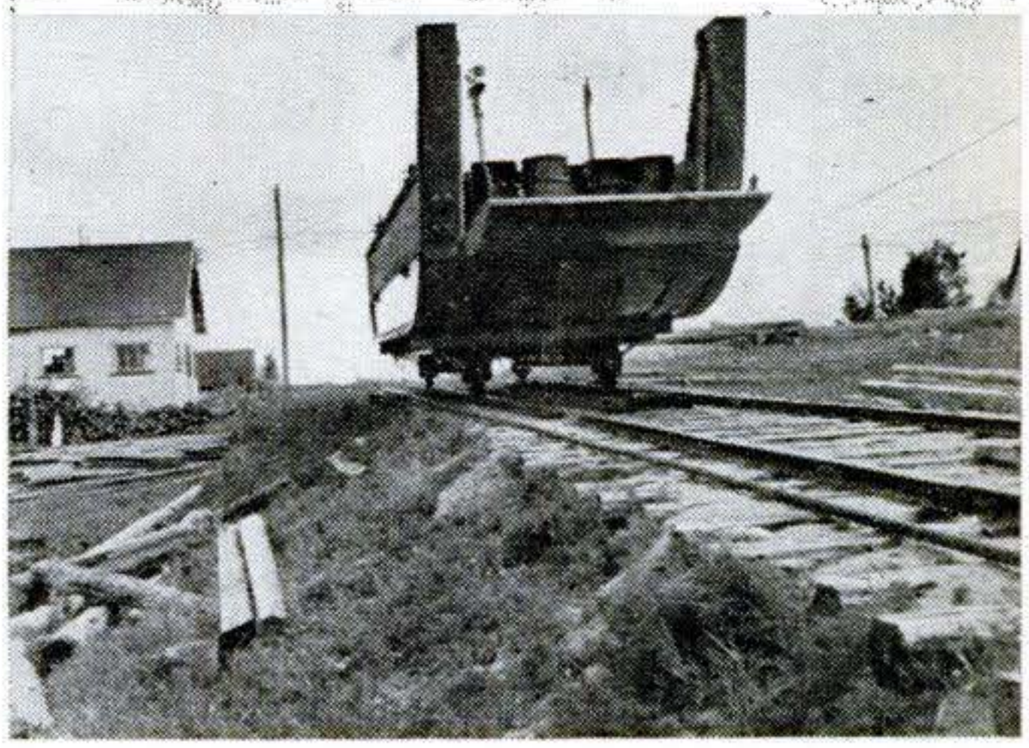


An empty scow crossing on the cable railway at Sam's Portage. Chukini River's rapids in background show why craft is hauled out here.

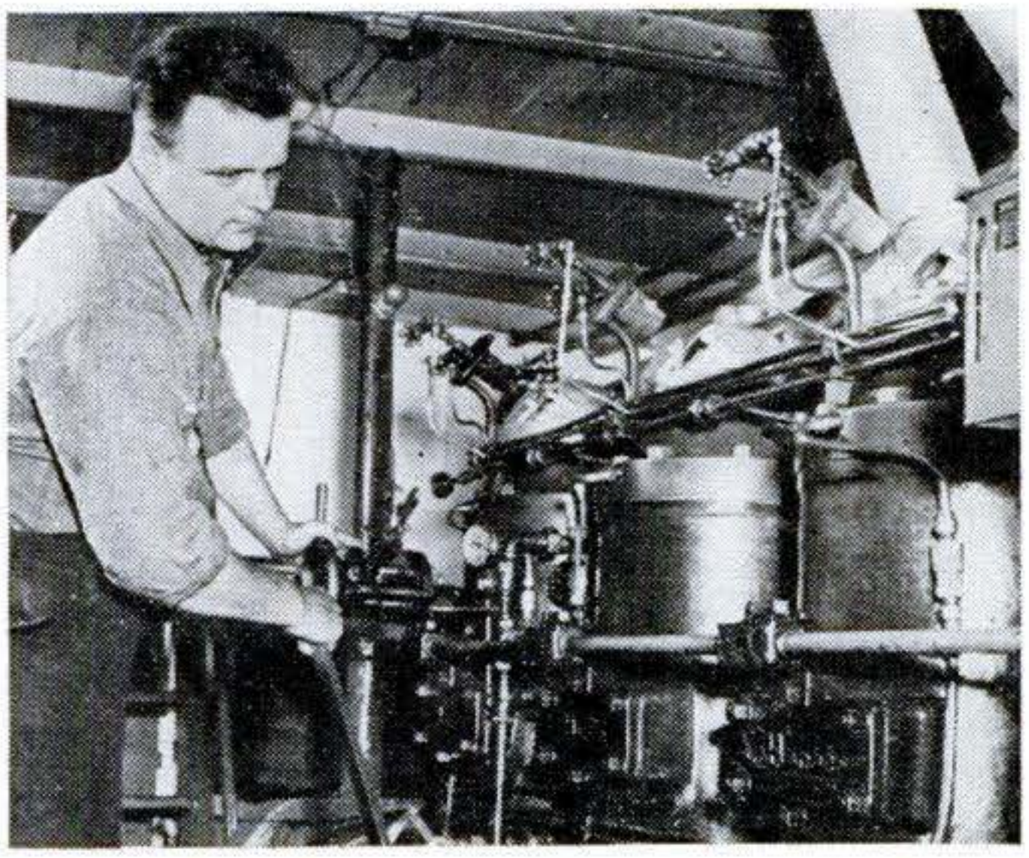


A scow slides into the water with a great splash after crossing Sam's Portage. Loaded scows weigh from 15 to 25 tons; 150 of them are used.

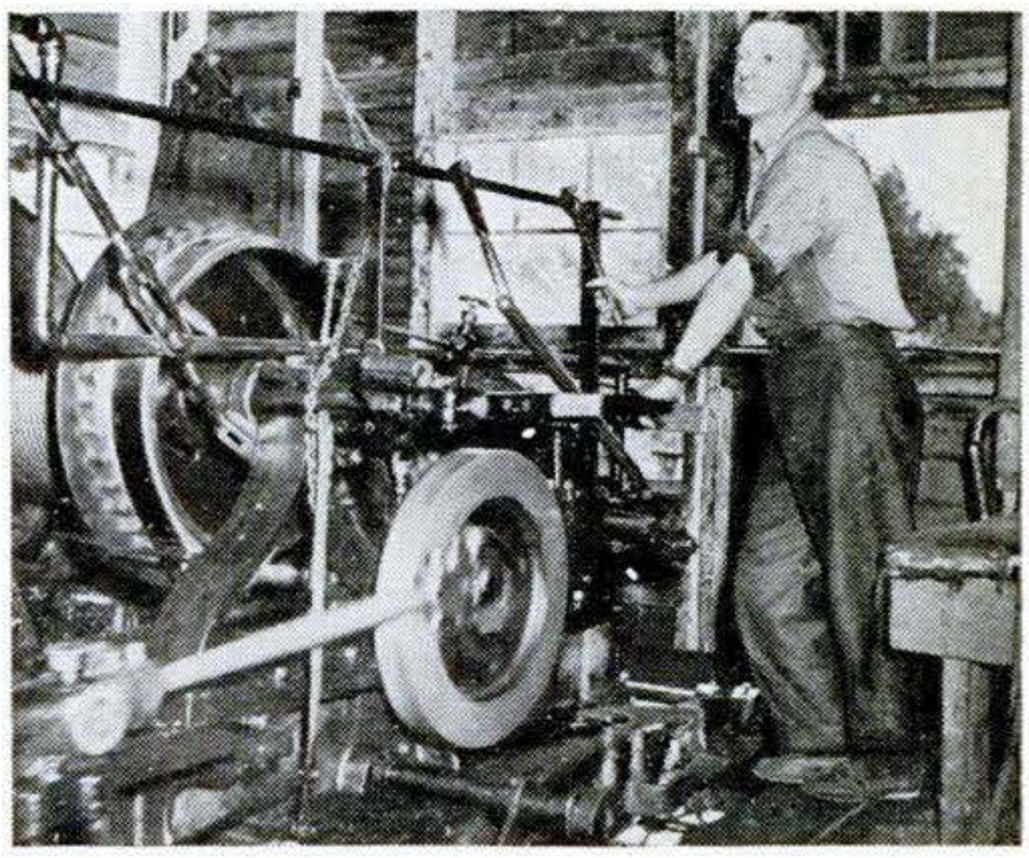
Empty cradle is run into the water at Sam's Portage, where scows will be floated onto it. Swing of five scows and tug can be carried in one operation.



Wartime landing craft, bought from the Canadian government, have been converted for the run. The rail portage also carries canoes and boats.



Engineer Sig Ericson with hand on throttle of one of Patricia Transportation Company's 15 tugs. Tugs are 25 to 30 feet long and are mostly Diesel-powered. Newest ones are metal, replacing wooden type. Tugs are transported in pieces to Hudson, where they are assembled.



Hoistman Ed Roy tending his 70-hp. donkey engine at Sam's Portage. A hoistman must be on call day and night and keep boilers fired. Roy's nephew helps him cut the necessary 80 cords of wood from November to May, during which time the system is shut down except for emergencies.

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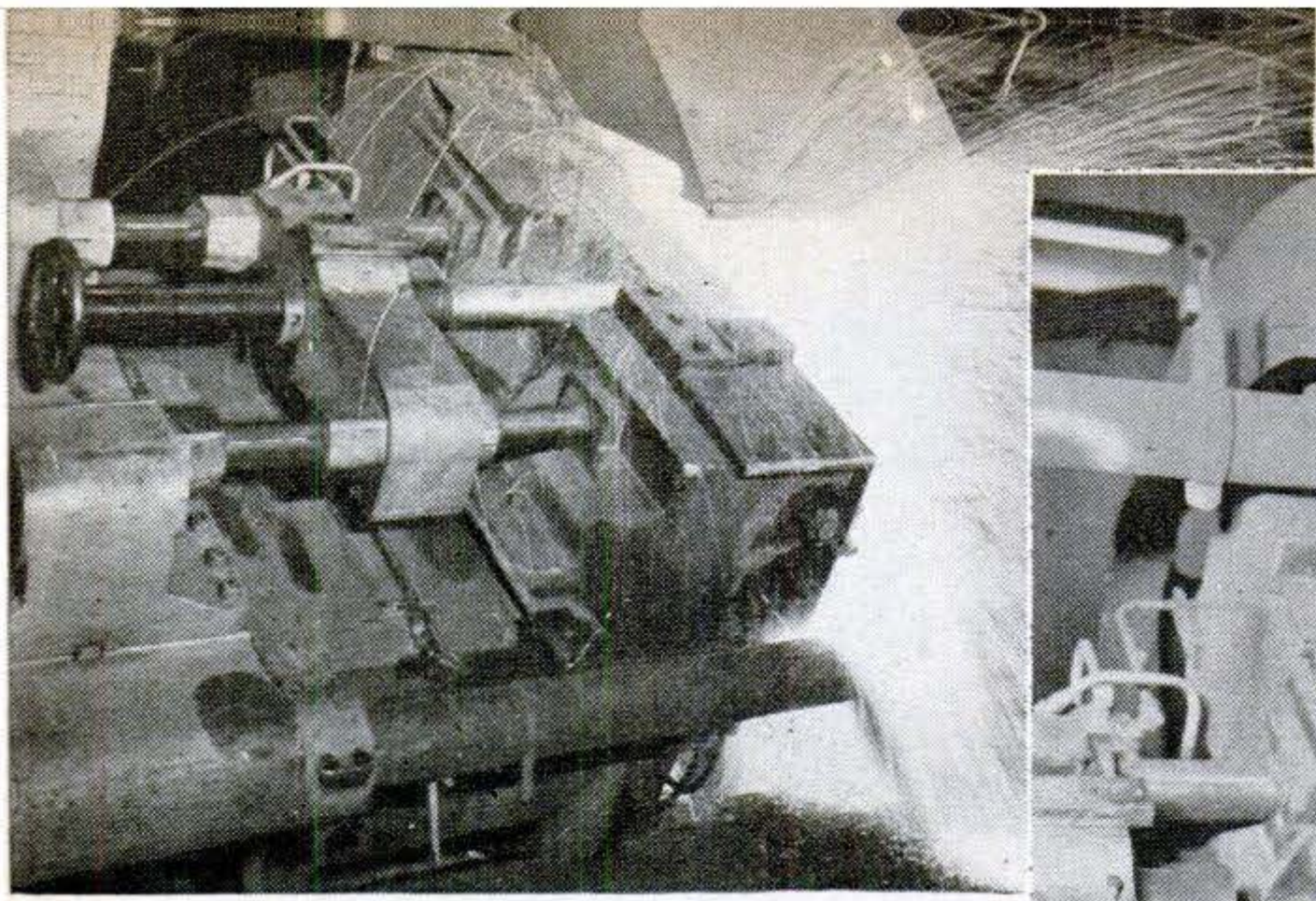
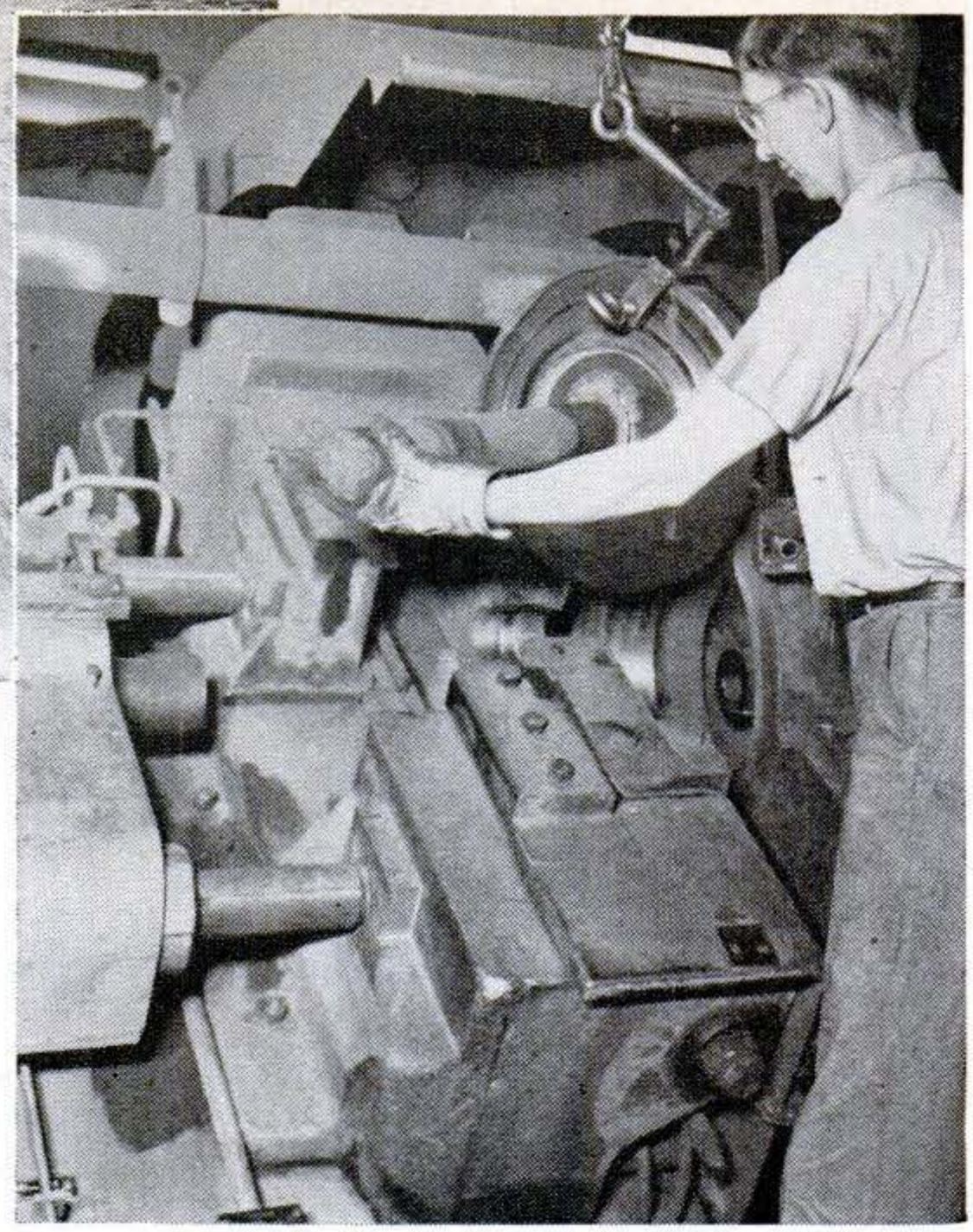
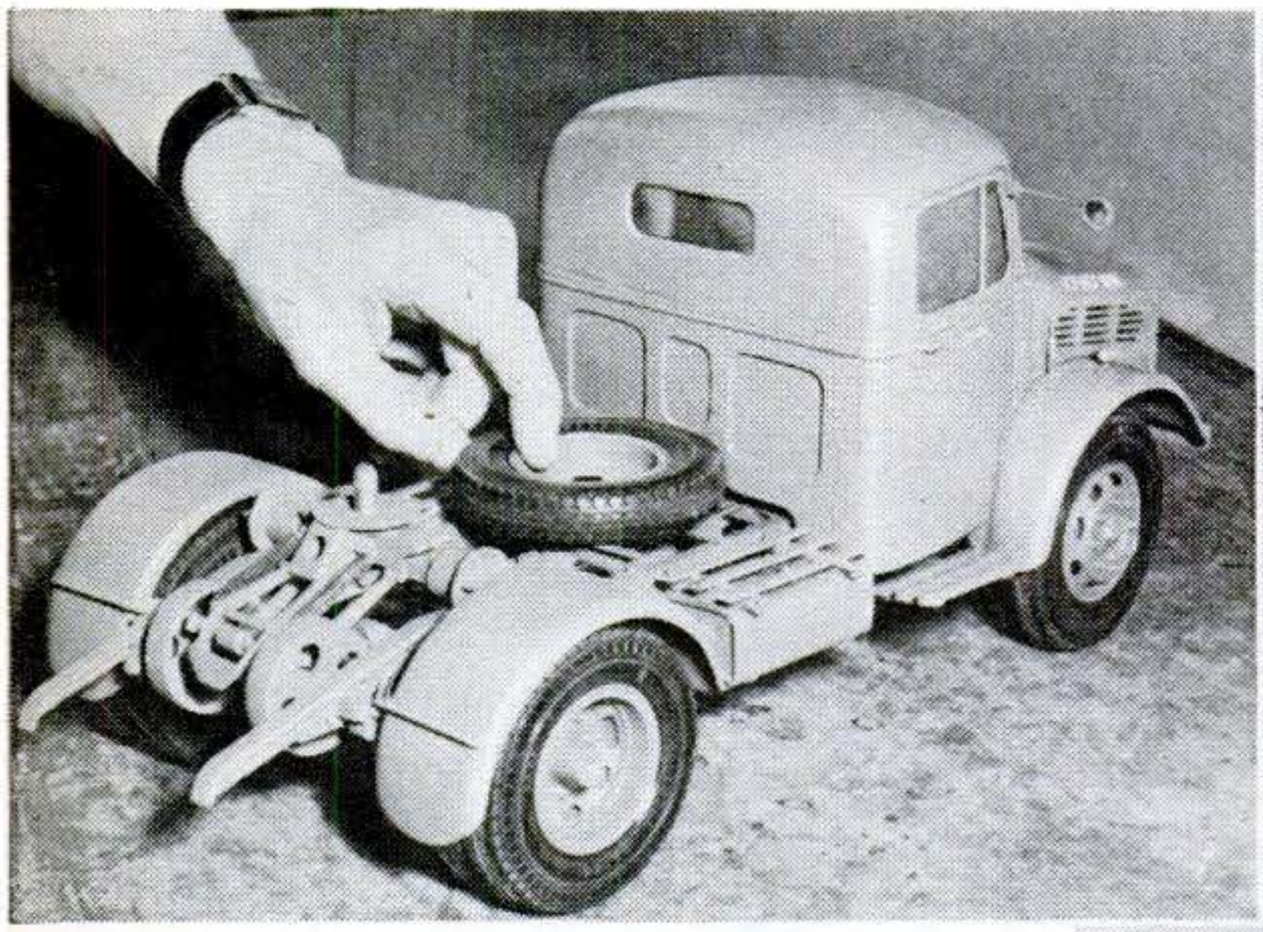
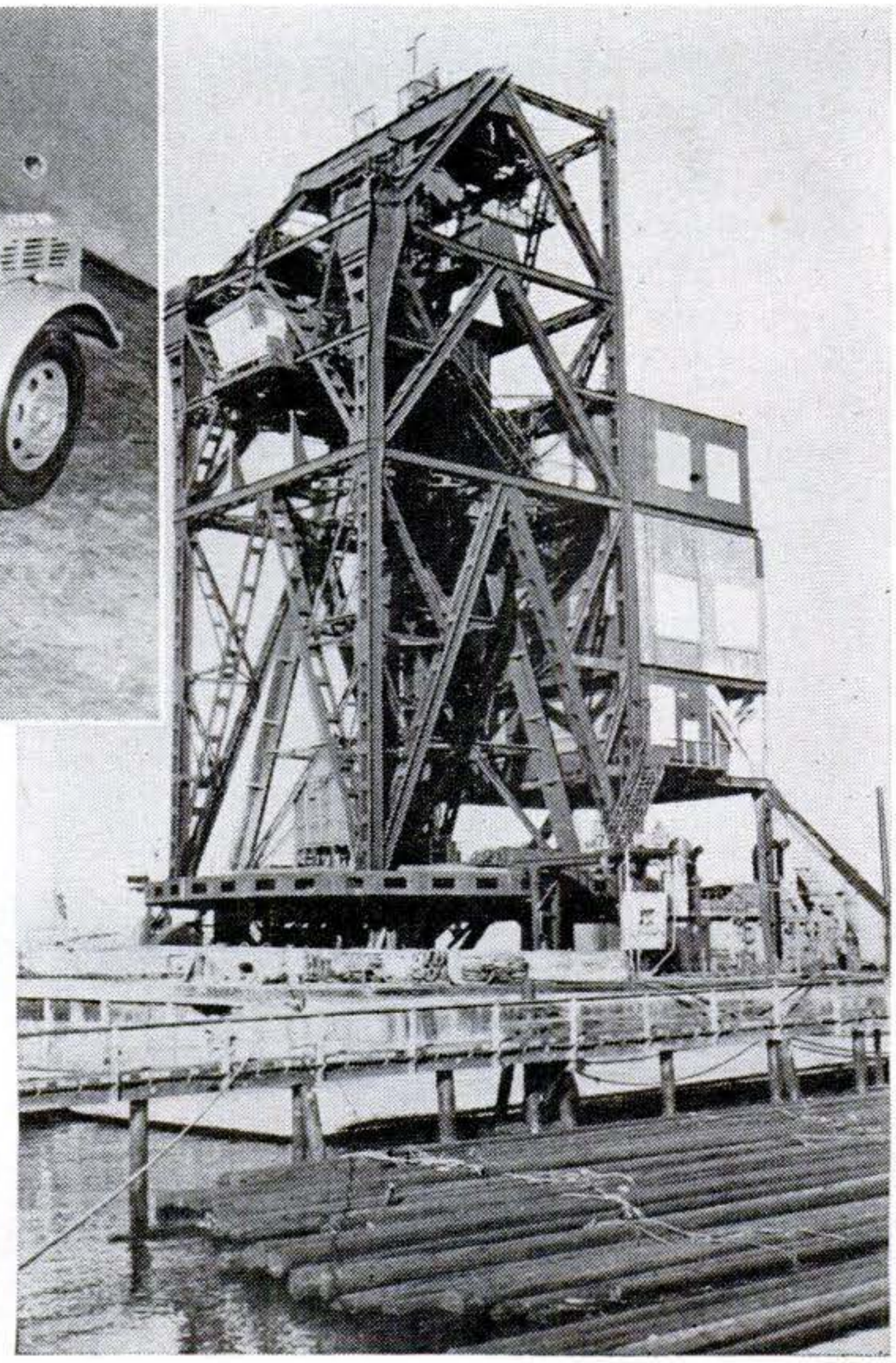




Squeeze-welding. The flood of sparks above comes from a shaft being automatically welded to an Allison turbine wheel under 240,000-lb. pressure. A 60,000-ampere current has made mush of the two faces at 2,600° F. To endure 1,500° F. in a P-80's jet engine, the wheel is cold-forged from a heat-resisting alloy. At right, the finished 214-lb. unit is taken from the welder.



Model Truck Sells Original. The model Vauxhall Bedford semitrailer above is realistic for a reason. When a prospect wants to know what a British car or truck looks like, the salesman pulls out a model. The models are made by Bassett Lowke.



Nazi Crane Joins the Navy. At right is one of the four largest self-propelled floating cranes in the world, built for the German Navy. It has been reassembled at the U. S. Naval Shipyard, San Pedro, Calif. The $3,000,000 crane lifts 350 tons.

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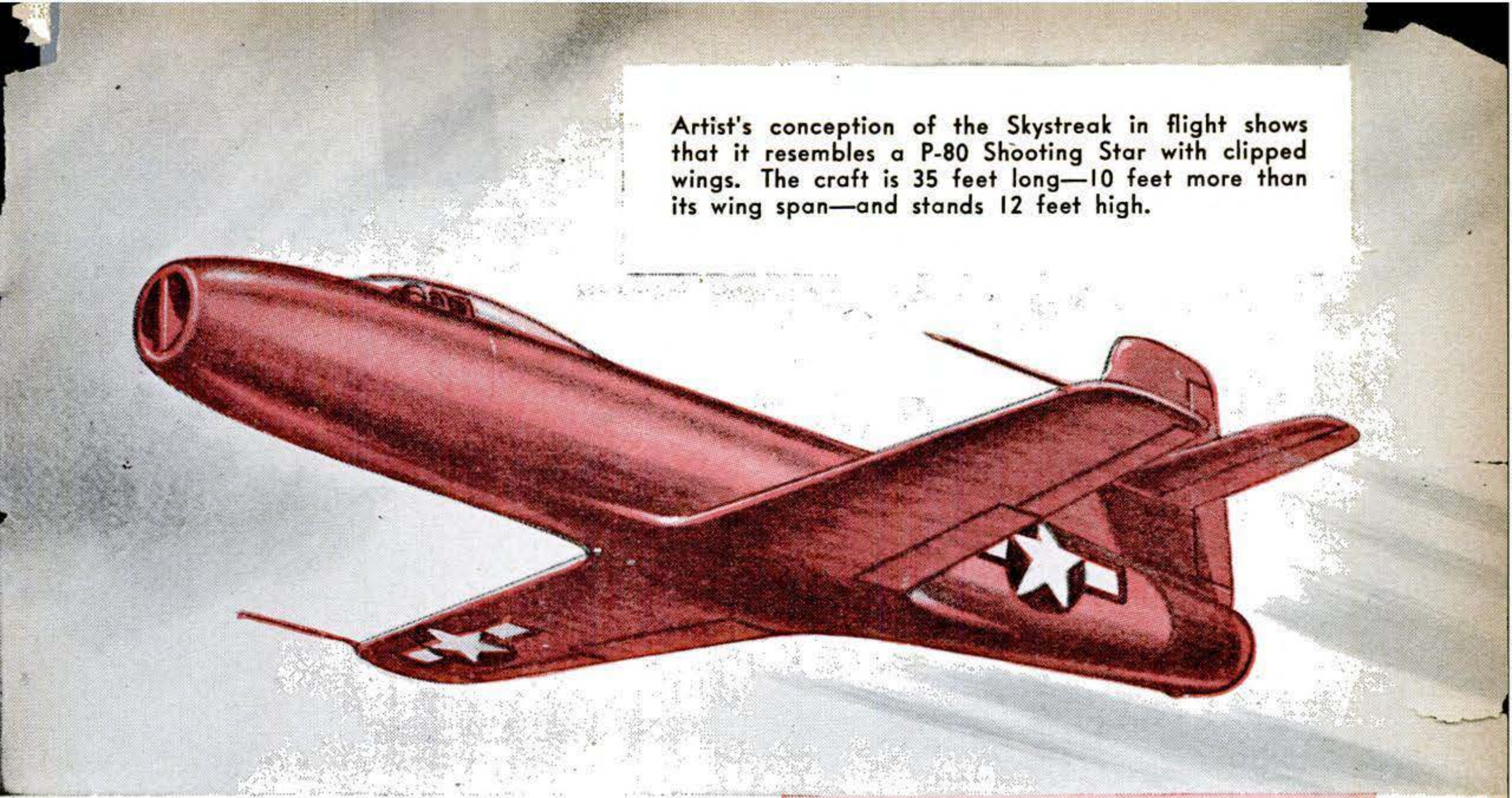

Artist's conception of the Skystreak in flight shows that it resembles a P-80 Shooting Star with clipped wings. The craft is 35 feet long—10 feet more than its wing span—and stands 12 feet high.

SKYSTREAK Heads for the Speed Limit

EFFORTS to smash past the speed of sound with a piloted airplane will be redoubled in coming months with a new sonic explorer, the Douglas D-558 Skystreak. Completed in February for the Navy Department's Bureau of Aeronautics, the stub-wing plane will slam a pilot, 500 pounds of recording instruments and a turbo-jet into the invisible wall existing at speeds above 600 miles an hour.

The Skystreak, built at the Douglas Aircraft Company's El Segundo, Calif., plant, weighs 9,750 pounds fully loaded but has a wing span of only 25 feet. Twenty-seven such wings, each 150 square feet in area, would be required to lift the mighty B-29. Yet the TG-180 turbo-jet engine develops a force equal to all four B-29 engines wide open. Air rams into the split nose, streams around the pilot's cockpit in two ducts to feed the huge engine, which occupies most of the fuselage above the wing.

The plane's speed, to be tested at Muroc, on the California desert, has not been disclosed. Unlike the Bell XS-1, the AAF's entry in the supersonic sweepstakes (PSM, Jan. '47, p. 81), which is launched from the belly of a B-29 flying at high altitude, the Skystreak will take off and land under its own power. Its flights will consist of level speed runs at its service ceiling to obtain aerodynamic data. Information gained during its sweeps toward the sonic barrier will be applied by builders to the design of commercial and military aircraft of the future.

To protect the pilot, the forward section of the fuselage is jettisonable. In an emergency, the pilot blasts the nose compartment clear. When his compartment slows down, he parachutes out in a normal fall. The cockpit is pressurized for high-altitude flights, and a cooling system has been installed to counteract the heat created by friction at critical speeds.

Because no one knows what violent behavior of the air will be encountered at transonic and supersonic speeds, the Skystreak, like the XS-1, is built to withstand loads 18 times greater than the force of gravity. Its fuselage is a long, smooth, extra-

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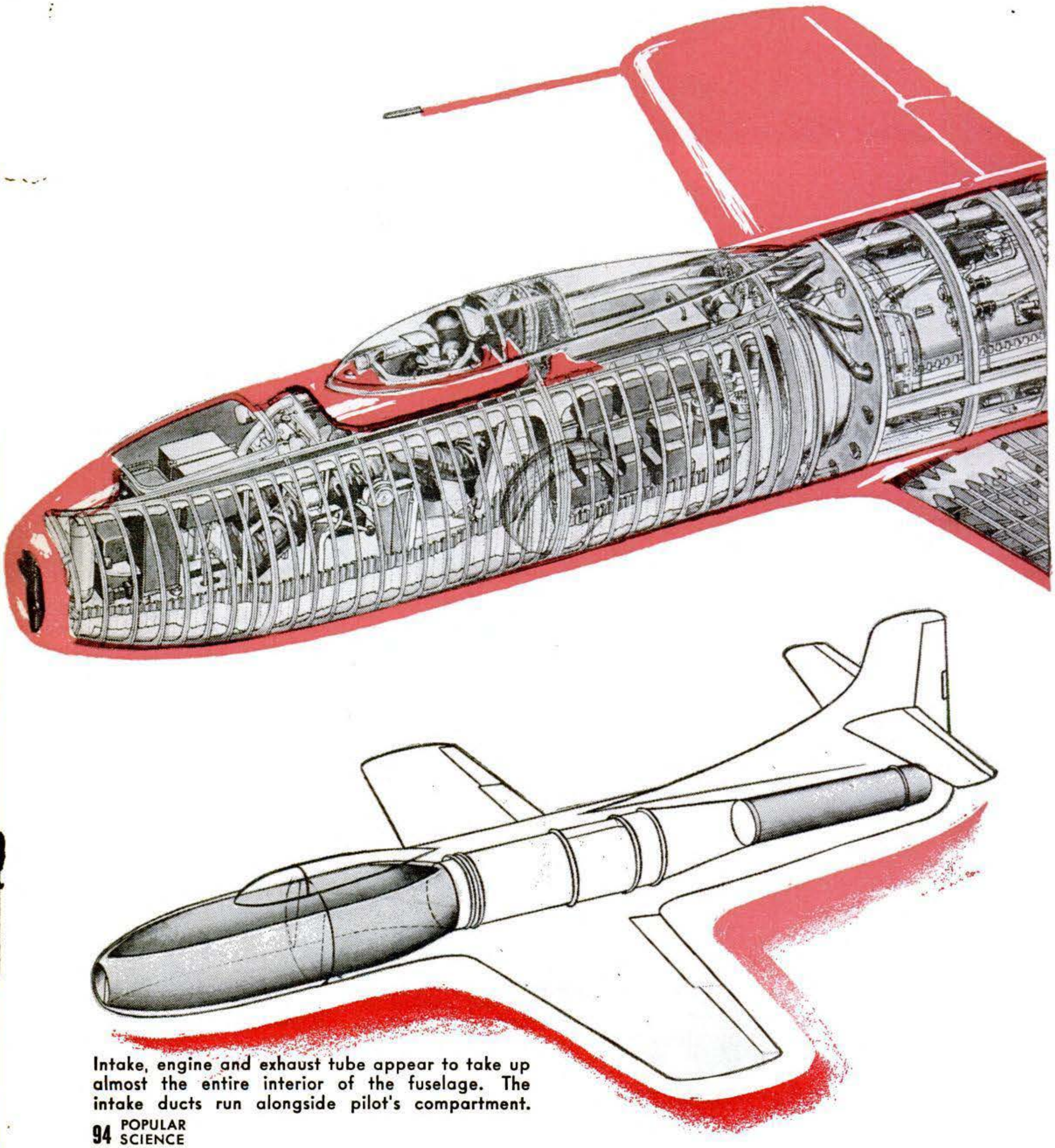
thick magnesium tube, with no internal cross bracing. The massive construction, it is hoped, will resist successfully the loads built up by the air at sonic speeds. Use of magnesium saves weight, permits the fuselage to be wrapped around the engine without wasting space, and is considered more fire resistant than aluminum under the expected flight conditions. The short, thin wings are fabricated from 75S, toughest aluminum alloy developed for airplane consti[illegible]m. The wing is so thin that to save spac[illegible] sten alloy counterweights, 50 percent [illegible] than lead, are used to balance the a[illegible]

Douglas and Navy engineers hope the D-558 will solve at least some of the mysteries of transonic flight. A total of 400 tiny openings in the wings, tail and fuselage will convey changing air pressures to automatic instruments carried behind the pilot. Gauges



Intake, engine and exhaust tube appear to take up almost the entire interior of the fuselage. The intake ducts run alongside pilot's compartment.

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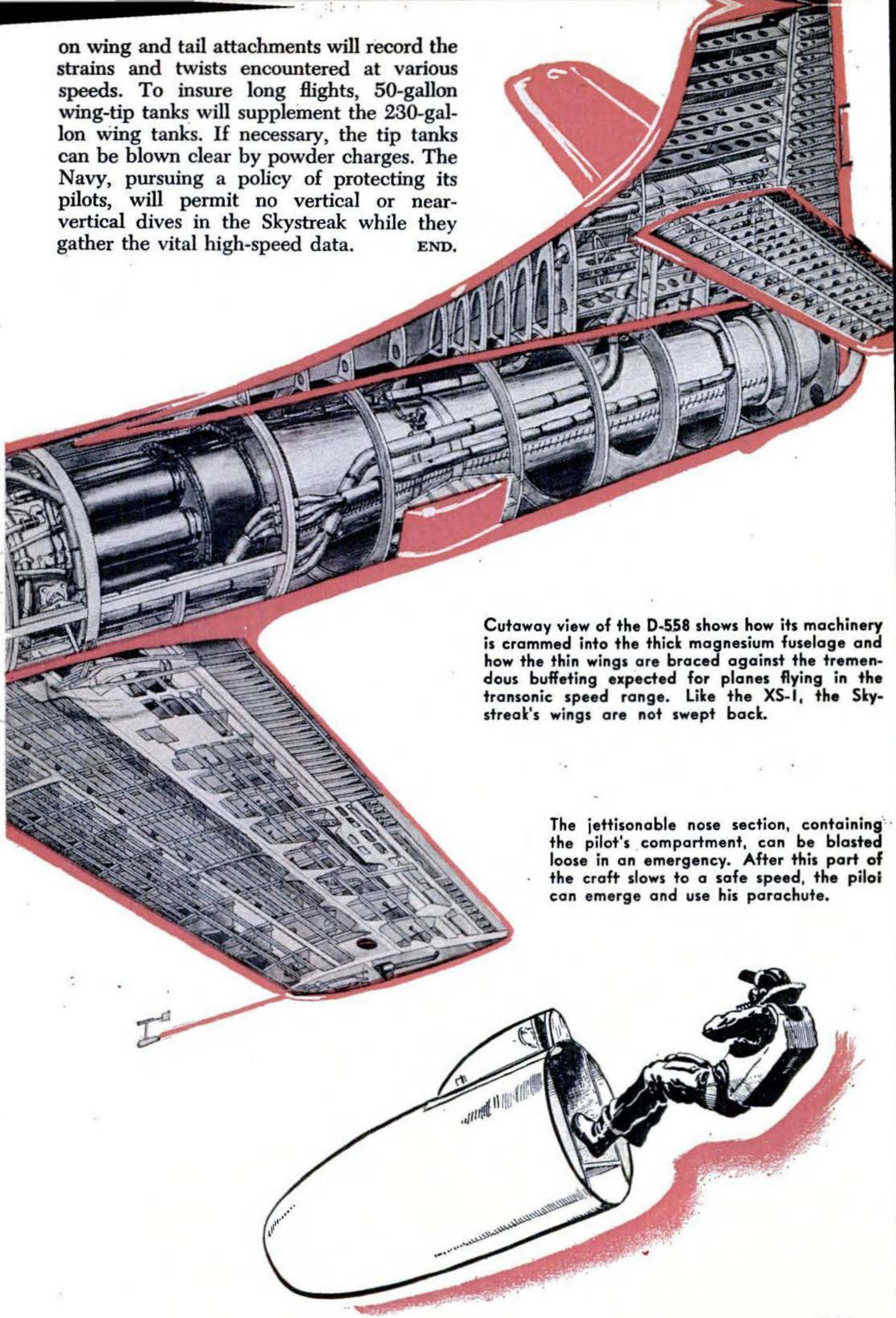
on wing and tail attachments will record the strains and twists encountered at various speeds. To insure long flights, 50-gallon wing-tip tanks will supplement the 230-gallon wing tanks. If necessary, the tip tanks can be blown clear by powder charges. The Navy, pursuing a policy of protecting its pilots, will permit no vertical or near-vertical dives in the Skystreak while they gather the vital high-speed data. END.



Cutaway view of the D-558 shows how its machinery is crammed into the thick magnesium fuselage and how the thin wings are braced against the tremendous buffeting expected for planes flying in the transonic speed range. Like the XS-1, the Skystreak's wings are not swept back.

The jettisonable nose section, containing the pilot's compartment, can be blasted loose in an emergency. After this part of the craft slows to a safe speed, the pilot can emerge and use his parachute.

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One of the scenes that cost less and came off more smoothly because it was first worked out with the aid of a miniature set is shown above. It pictures Seneca chief Guyasuta holding a white flag in his demand for surrender. The drawbridge in right background was built from the model in photo at right. Model is a reproduction of the counterbalanced drawbridge that protected Fort Pitt, constructed according to drafts found in the British Museum. Bridge's weight equals weight of a swing-down inner door. When door swings open, bridge is raised. A watch chain joins door and bridge in model.

At right: A craftsman lifts one of the removable walls of an inn, called the Gilded Beaver Tavern in the movie. In his left hand are tiny ale casks, one of the interior props used in the picture. Miniatures of goods that were traded to the Indians for furs are glued to the shelves. The come-apart construction reveals how almost any sort of camera shot can be studied. As *Unconquered* is in Technicolor, all parts of the miniature set were painted to resemble the full-size version. Even ocean-going ships and river boats appearing in the film were first mocked up in 1/24-size models. Below: An interior shot of the tavern, appears in the film.

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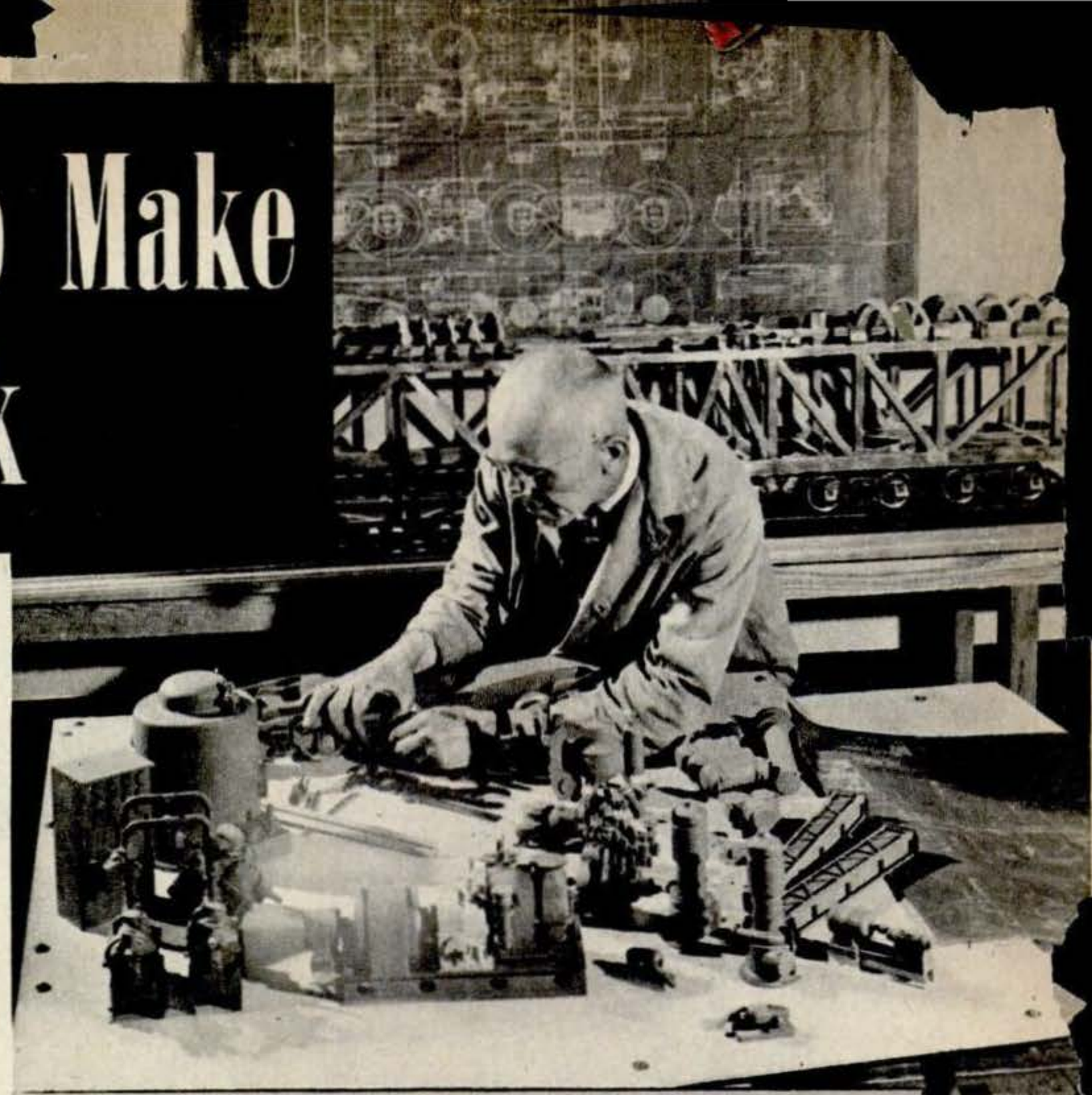
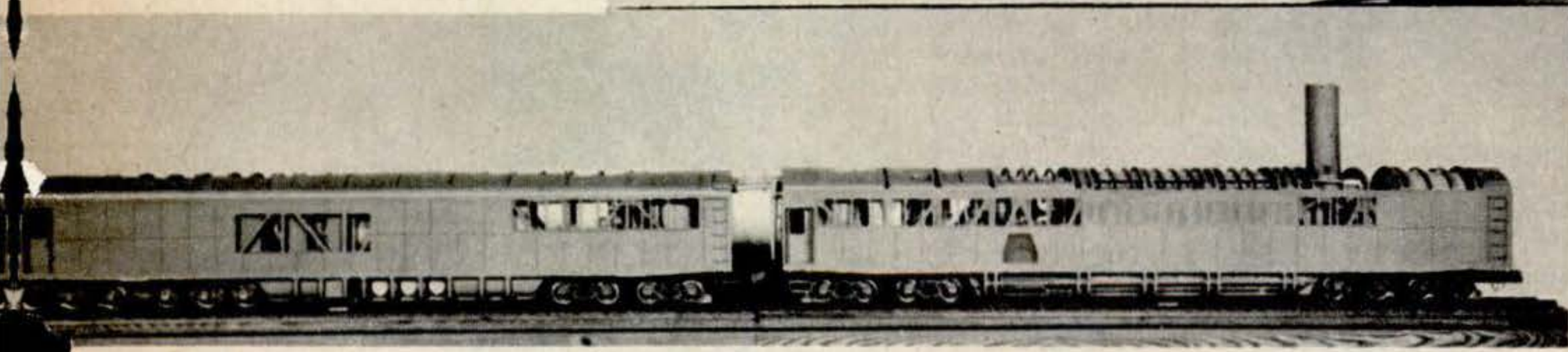
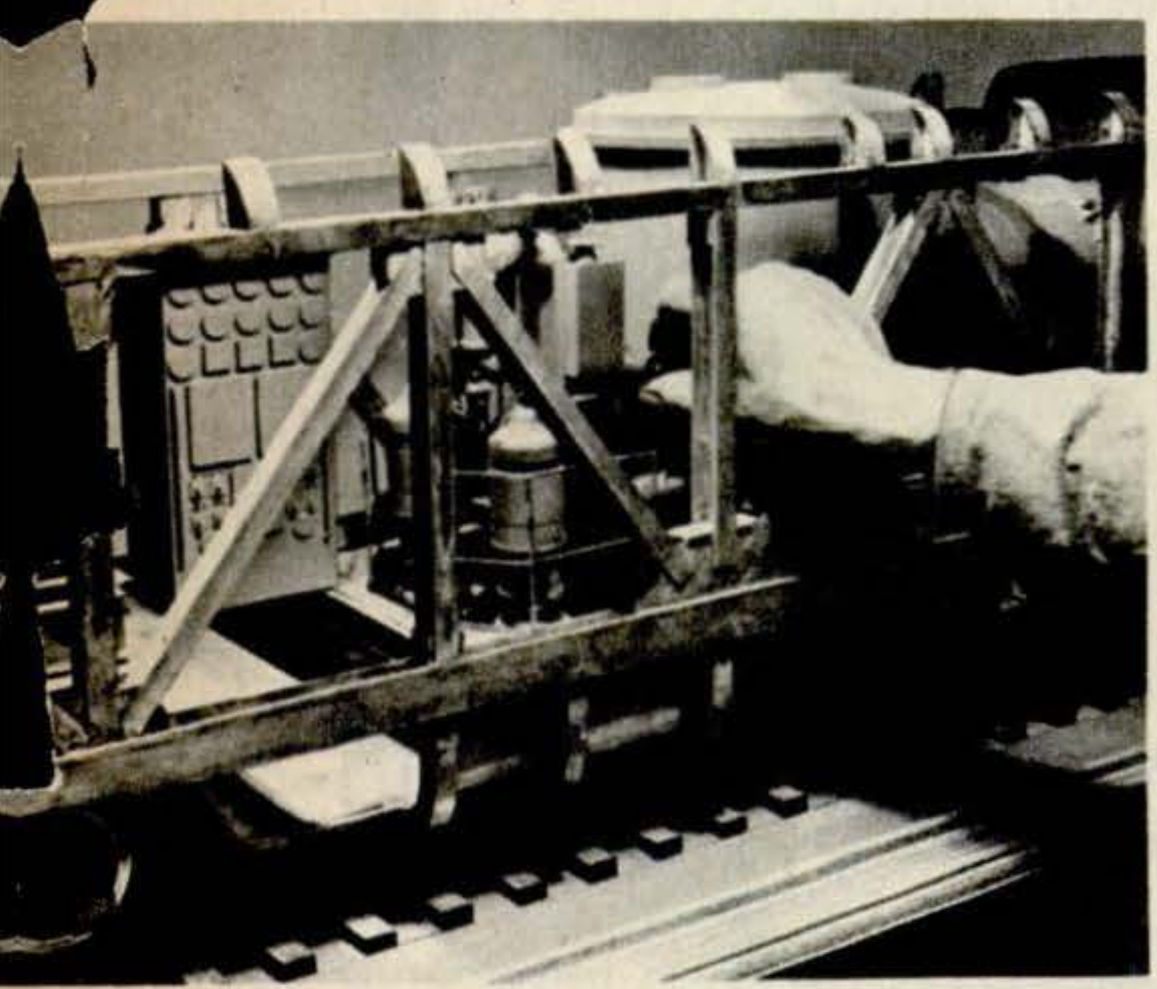
DELS Help Make dustry Tick



Modelmaker Chesebro working on his most complicated project, a scale model of a 10,000-kw. power plant mounted on two railroad cars. Scale was 1/2 inch to the foot. Below is the model, which Chesebro and an assistant worked on for 10 months. Car on left carries boilers to power huge turbine generators in car on right.





Setting a tiny valve in place on a turbine generator of the mobile power plant model. Built to supply emergency power for bombed-out cities, full-size mobile plant was never needed for original job but powered remote industrial installations.

HOWARD E. CHESEBRO'S job is a workshopper's dream: He makes exact scale models of everything from airports to appliance stores—and is paid for his fun. For Chesebro is General Electric's official modelmaker—and GE engineers have found that it saves time and money to have him turn their blueprints into three dimensions before building the real thing.

Chesebro's products range in scale from full size to 1/100 inch to the foot. His materials are equally varied: white pine for carvings, maple for wood turnings, brass and galvanized iron for structural members, white metal and aluminum for cast pieces. His outfit includes metal and wood lathes, sanders, circular saws, jointer planers, casting flasks—plus woodworkers' and machinists' finishing tools.

You'll find Chesebro any evening after work in a barn on his farm at Rotterdam, N. Y. But don't look for cows. The barn houses his home workshop. Chesebro spends his spare time making models.

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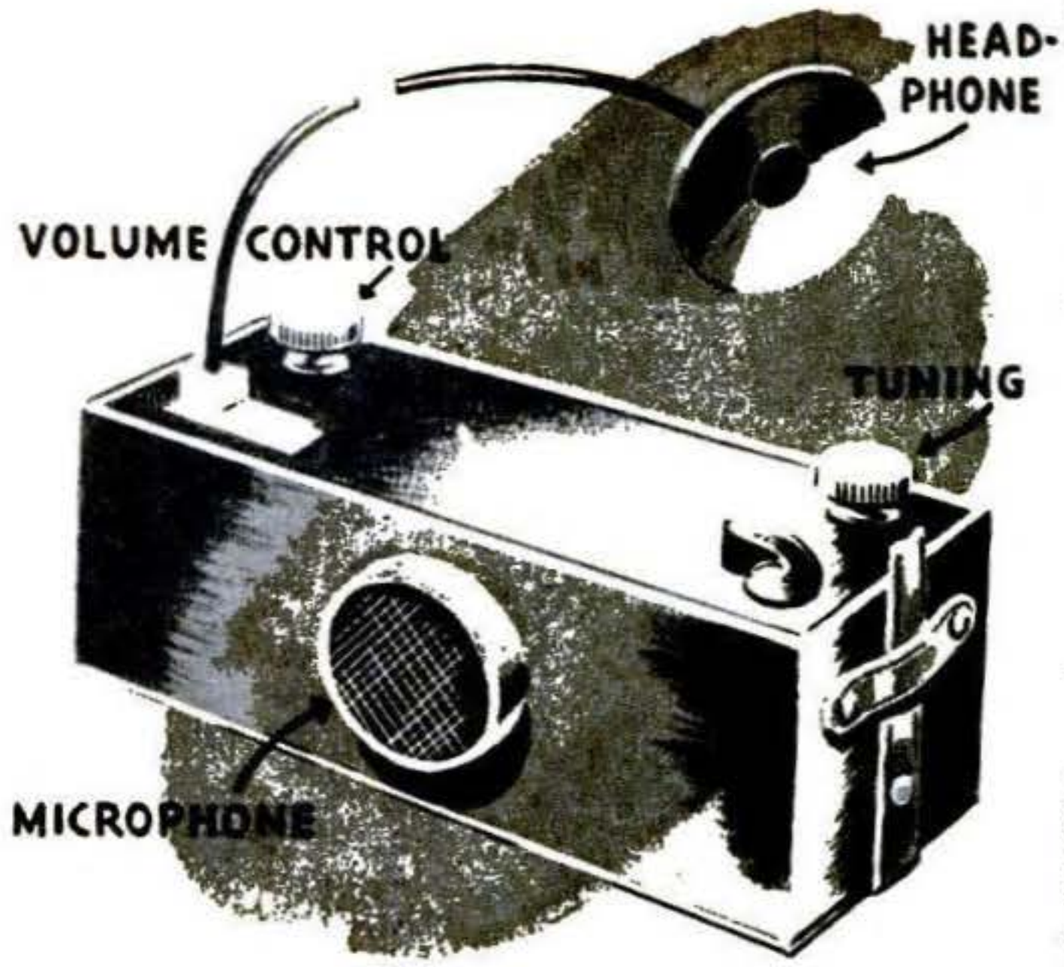
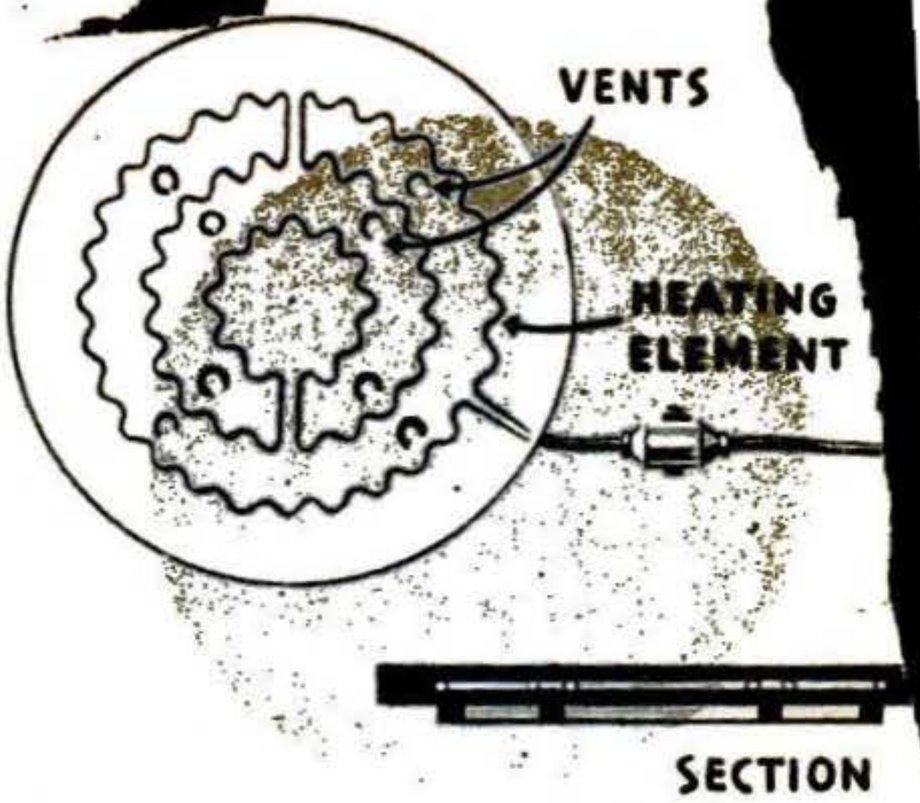
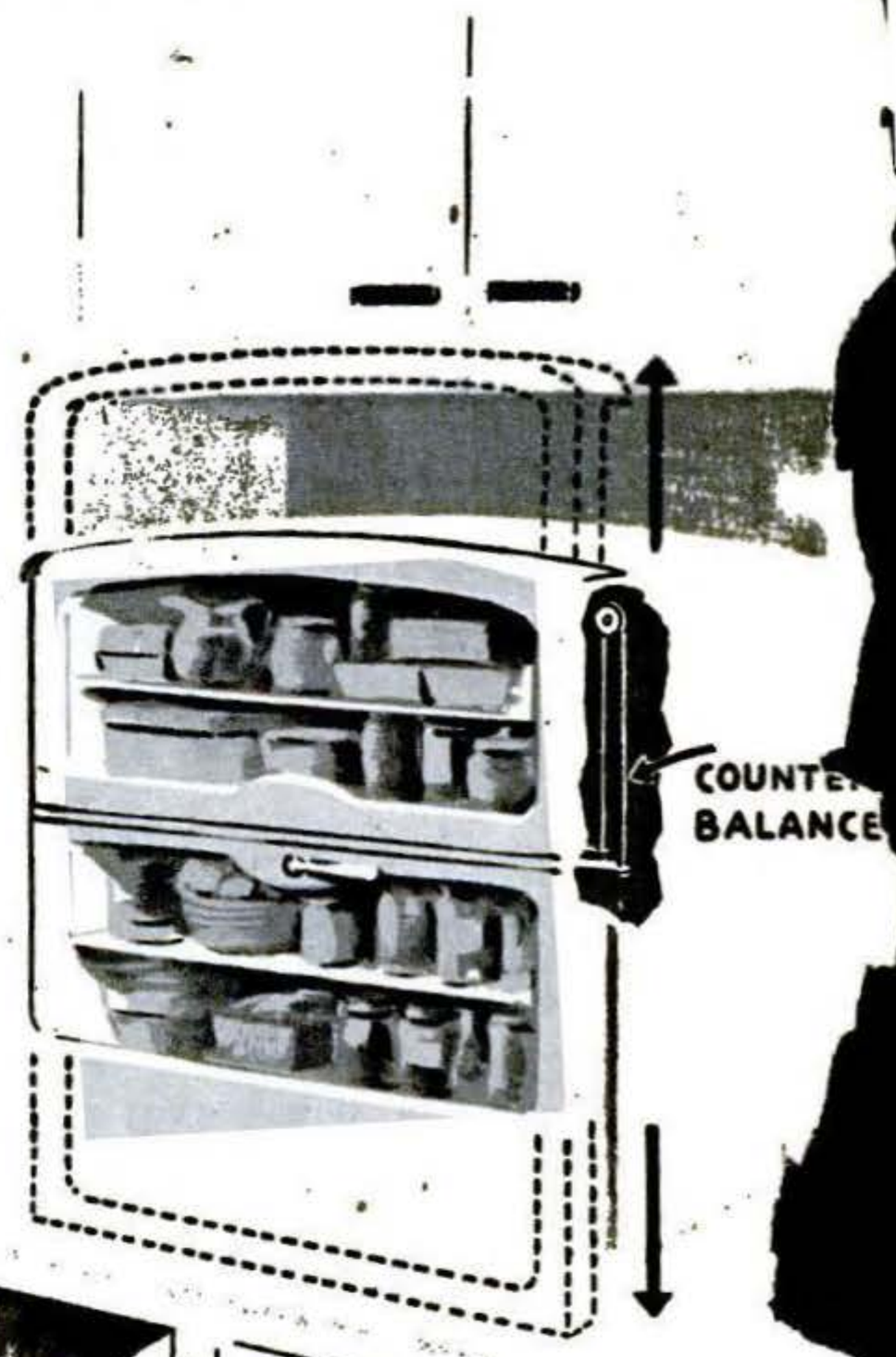


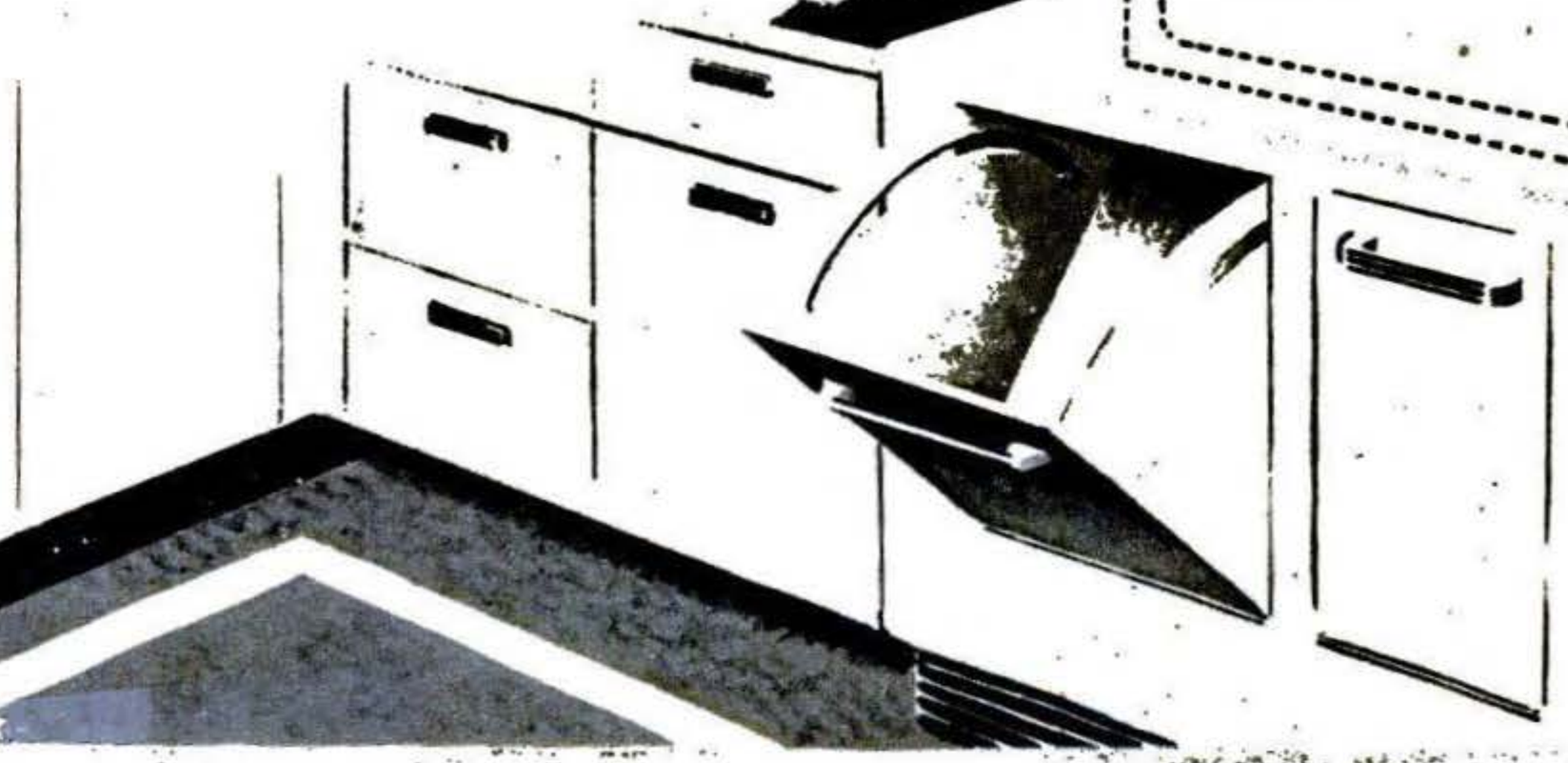
Radio Is Also Hearing Aid. The combination hearing aid and radio receiving set above, invented by Thomas B. Fordham and Thomas W. Moore, has a superheterodyne receiver, a built-in loop antenna, a headphone and a microphone, so that two persons who are hard of hearing may also use it to converse.

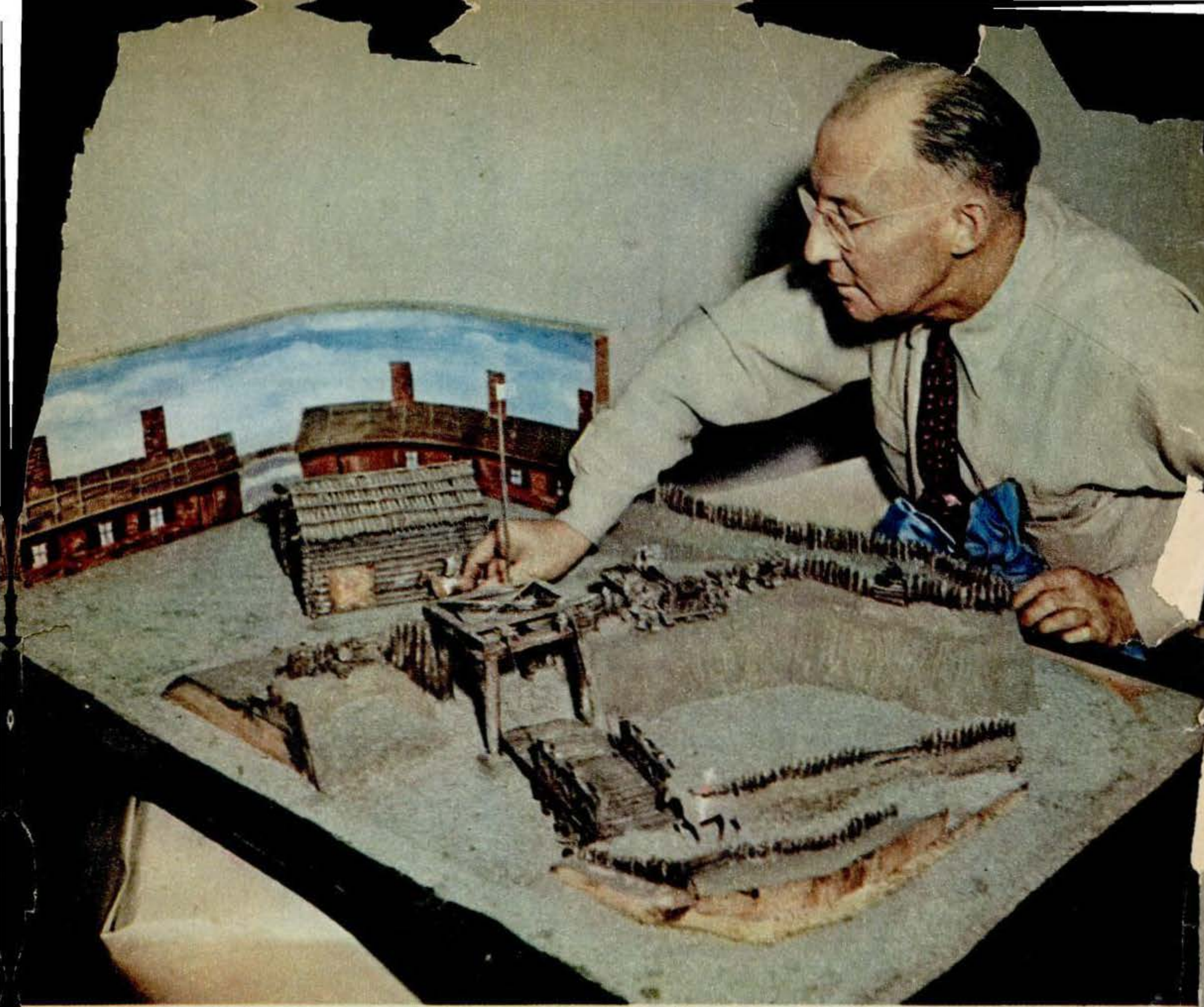


Hot Plate Made of Glass. By embedding circularly arranged wire coils in Pyrex glass, inventor John Bilan has devised a novel electric hot plate. The holes in the plate provide draft.

Worktable Refrigerator. The refrigerator at the right has a work surface that does not have to be cleared to open any of the four doors of its compartments. The door of the top compartment slides upward and the door of the one underneath it slips downward when a handle on the front of the refrigerator is moved. The other two doors are under the work surface. It was invented by Harold Van Doren.







According to historical research, this is how Fort Pitt, situated at the forks of the Allegheny and the Monongahela rivers, appeared in 1763. The buildings painted on the backdrop depict barracks for troops. The miniature-maker is putting a model horseman in position—one of many steps required in planning a particular scene.

Miniature Fort Guards Movie Budget

NOTHING spills dollars out of a movie producer's budget bag quicker than delays on the set after his cameramen have begun shooting the actual picture. So now, borrowing a practice increasingly favored by progressive industrialists, producer Cecil B. DeMille first builds his studio sets to scale in miniature so he can plot definite scenes, action and camera angles long before the cast and the technical staff for a picture go on the pay roll.

Recently DeMille had a scale-model, diminutive Fort Pitt built in Hollywood, and he studied it thoroughly before starting to film *Unconquered*. The model of the colonial fort's houses, fortifications and bridge was built 1/24 the size of the actual studio set. Its structures had removable parts that were lifted out for planning interior scenes and shots in the film's version of the 90-day siege of the fort in 1763, during the French and Indian War. Fort Pitt was built on the site of the modern city of Pittsburgh.

stream can deliver many times this minimum.

The power available at the site of a water wheel (that is, before deductions for inefficiencies in the wheel and generator) is expressed in this formula:

$$\text{Hp.} = \frac{62.4 \times Q \times H}{33{,}000}$$

Here Q is the cubic feet of water passing through the wheel in one minute; H is the "head" or vertical distance in feet through which the water falls; 62.4 is the weight in pounds of 1 cu. ft. of water; and 33,000 the number of foot-pounds per minute in 1 hp. A number of methods exist by which the variables Q and H can be determined, but before considering them, it's well to examine first the possible sites for the dam and wheel, since they will necessarily affect the amount of head secured.

The location of the dam, as suggested in Fig. 1, should be governed by two principles. It should be placed where the greatest useful head is obtainable, that is, where the greatest

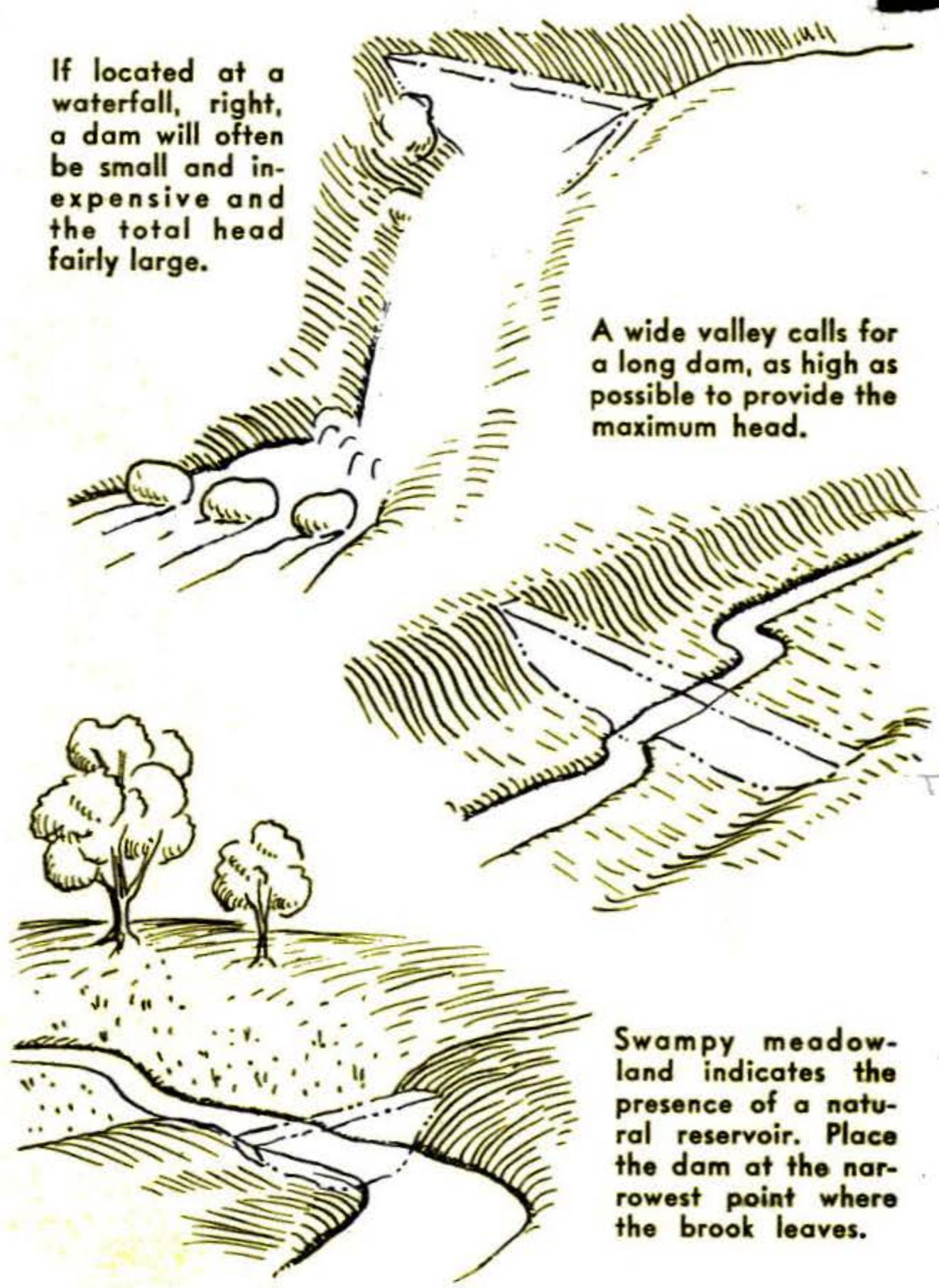
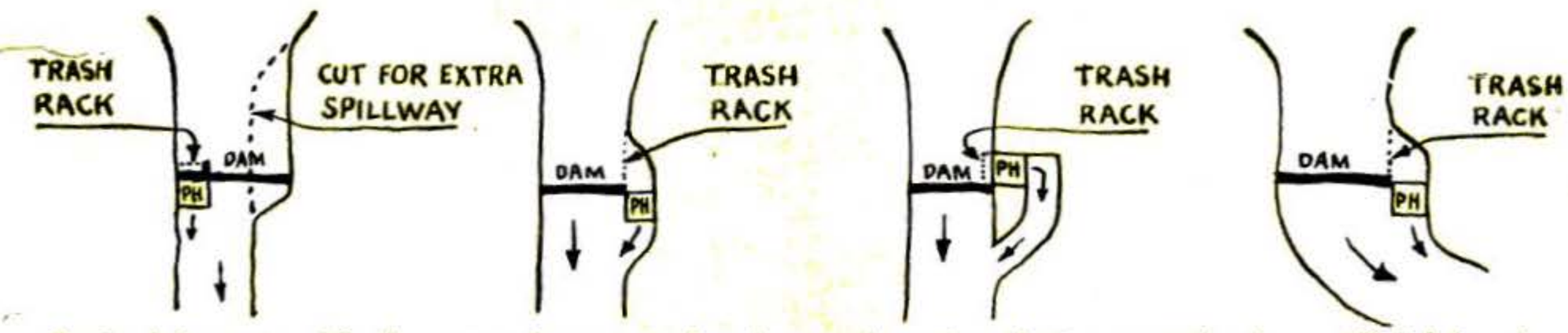
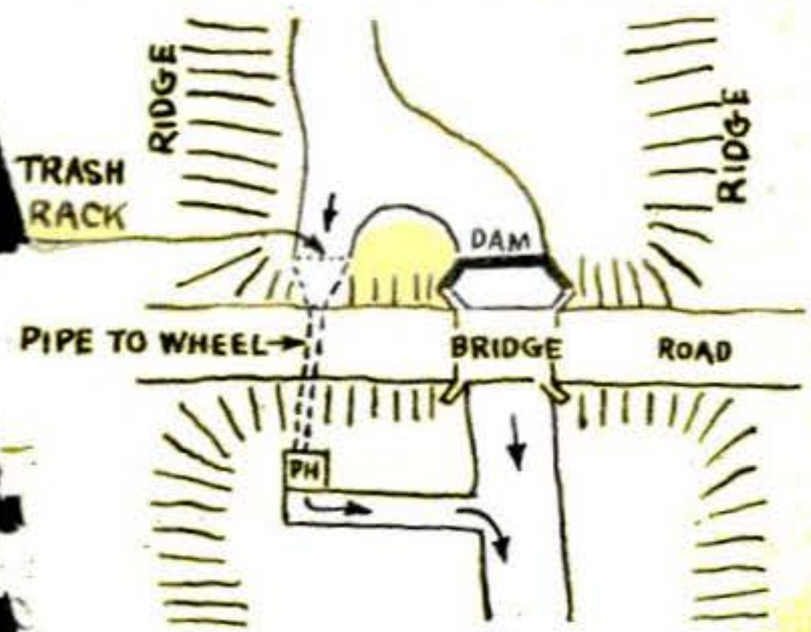


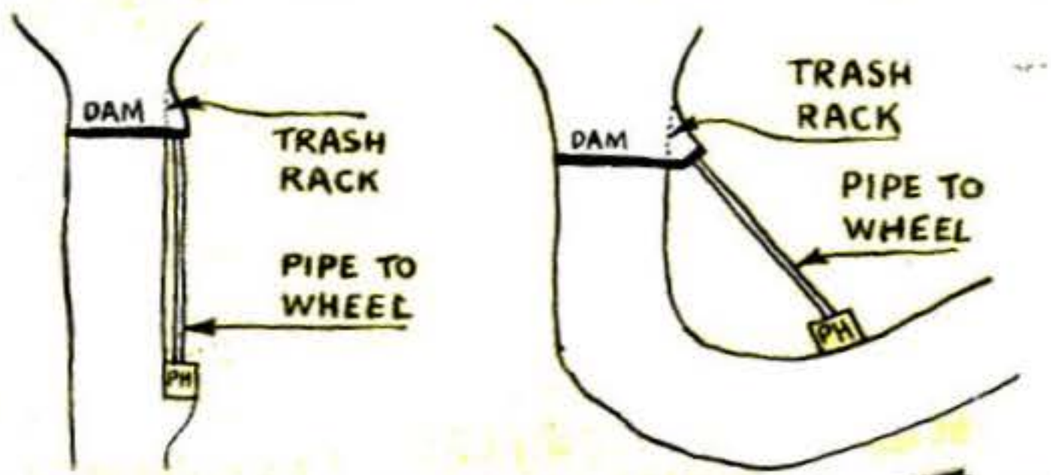
FIG. 1. LOCATING THE DAM

FIG. 2. LOCATING THE WHEEL

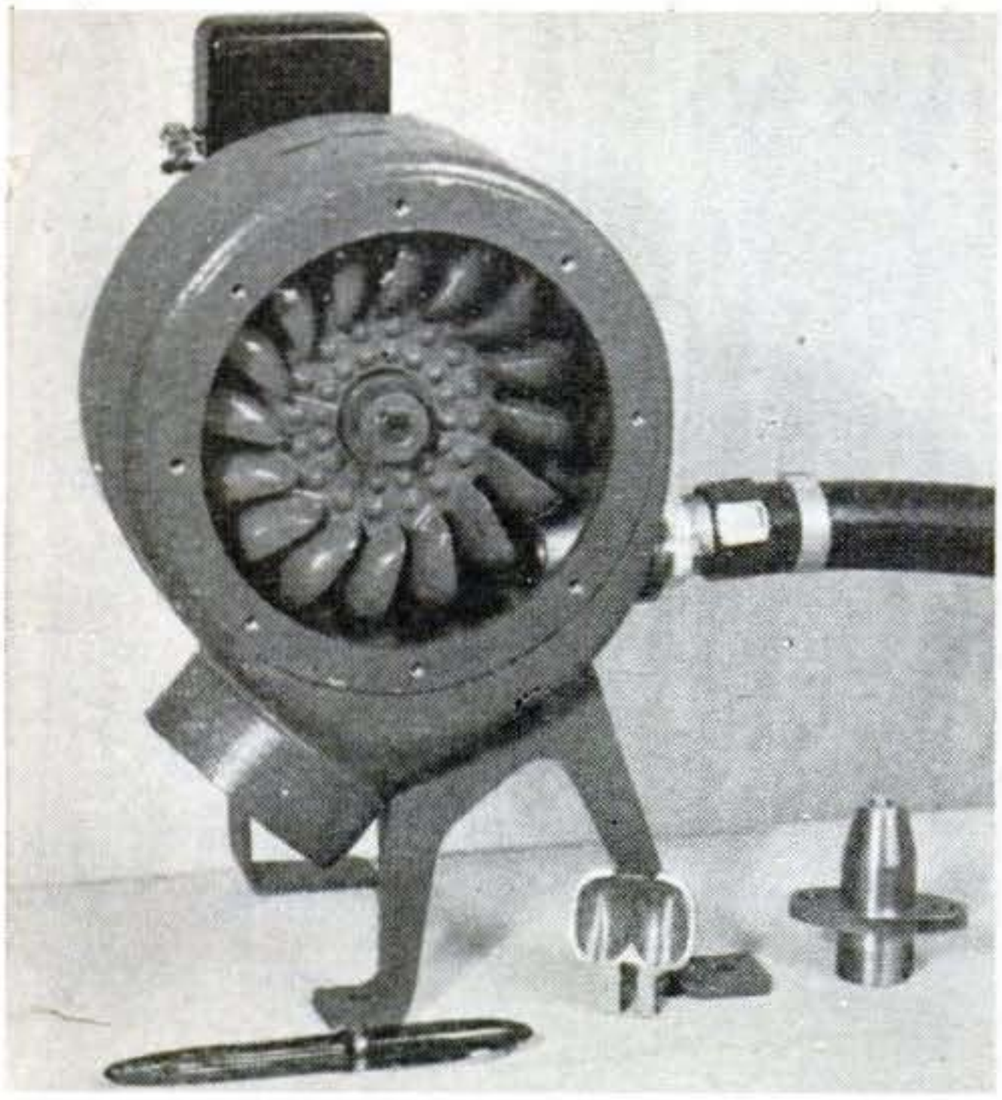


Typical layouts with the powerhouse at the dam, a location that uses only the artificial head.





Typical "divided-fall" layouts, with the wheel [illegible] dam, which add the natural to the arti[illegible]



Fitz Water Wheel Co.

This 4" impulse wheel, built for war requirements, was direct-connected to a small generator. It can be run off an ordinary water faucet. Note the removable nozzle and the tiny bucket, lower right.

fall occurs in the shortest length of stream. Such a site is often indicated by a natural waterfall, by a conspicuously steep slope, or by the swiftness of the current. The second locating principle is a simple matter of cost: a dam should be placed where it can be smallest and still impound the most water. This means, in general, that it should be placed where the stream valley or cut is narrowest.

The site of the water wheel, Fig. 2, may e either at the dam or some distance below The former location is the more common, being simpler to build and eliminating e need for a pipe or penstock to deliver ater to the wheel. Disadvantages include fact that the spillway must be of ample city to protect the powerhouse in time high water, and the fact that only the artificial head"—that created by the dam self—is available. In cases where the ground falls away abruptly below the dam site, the "divided-flow" layout may be desirable, for it greatly increases the head.

Another preliminary calculation should be made [illegible] the height of the proposed dam. T[illegible]ted, as a rule, only by the h[illegible] walls at the site, an[illegible] pment, and money [illegible] The higher it is, [illegible]arger the pond that will be created. "Pondage"—water stored for use in times of peak demand—is an important factor in water-power calculations. Power is rarely needed 24 hours a day, and construction of a dam of sufficient height to provide water storage will greatly increase the power available at the time of day required.

If, for example, a wheel is to be run for 16 hours a day, and if a dam is built that will impound all water flowing into the pond during the idle eight hours, the power capacity will be increased by 50 percent. Don't neglect to distinguish between "live storage"—the volume of water represented by the difference in height of the spillway flash boards and the wheel intake—and "dead storage"—the volume of water below the level of the wheel intake. The former is power banked against a time of need; the latter is worthless, powerwise.

Once the dam and powerhouse are tentatively sited, and the height of the first is provisionally set, it is time to measure the power available. Assume that all w[illegible]er flowing in the stream can be made to [illegible] through the wheel, which is a fair ass[illegible] tion on small installations. This flow [illegible] in the power formula) can be determ[illegible] by the "weir method," which involves constructing a temporary dam of controlled proportions and which will be detailed in a subsequent installment, or by the "float method," which is theoretically a trifle less accurate, though still quite satisfactory.

The float method (Fig. 3) involves the formula:

$$Q = A \times V \times 60$$

in which Q is the volume of water flowing in cubic feet per minute, A is the cross-sectional area of the stream in square feet at the site, and V is the average velocity of the stream at this point, expressed [illegible] feet per second.

Select a length of the stream that is f[illegible] straight, with sides approximately pa[illegible] and unobstructed by rocks or shoals [illegible] distance of about 100′. Stretch a taut [illegible] squarely across the stream near the mi[illegible] of this length and measure the width of the stream here in inches. Mark this width off on the wire and divide it into ten equ[illegible] divisions. From the center point of each division, measure the depth of the wat[illegible] in inches. Then average the depth figur[illegible] by adding each value and dividing by 1[illegible] The cross-sectional area of the stream, [illegible]

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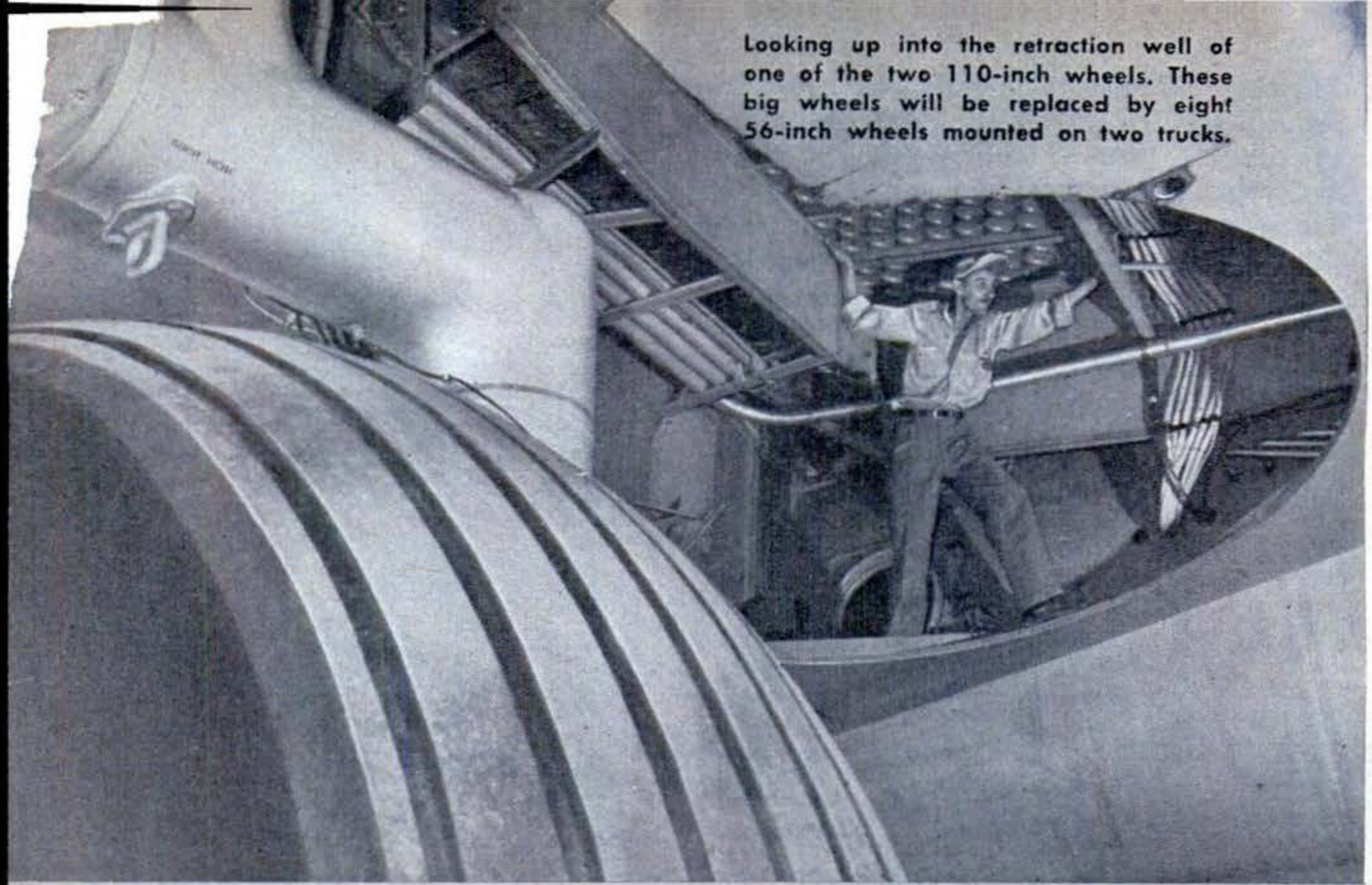
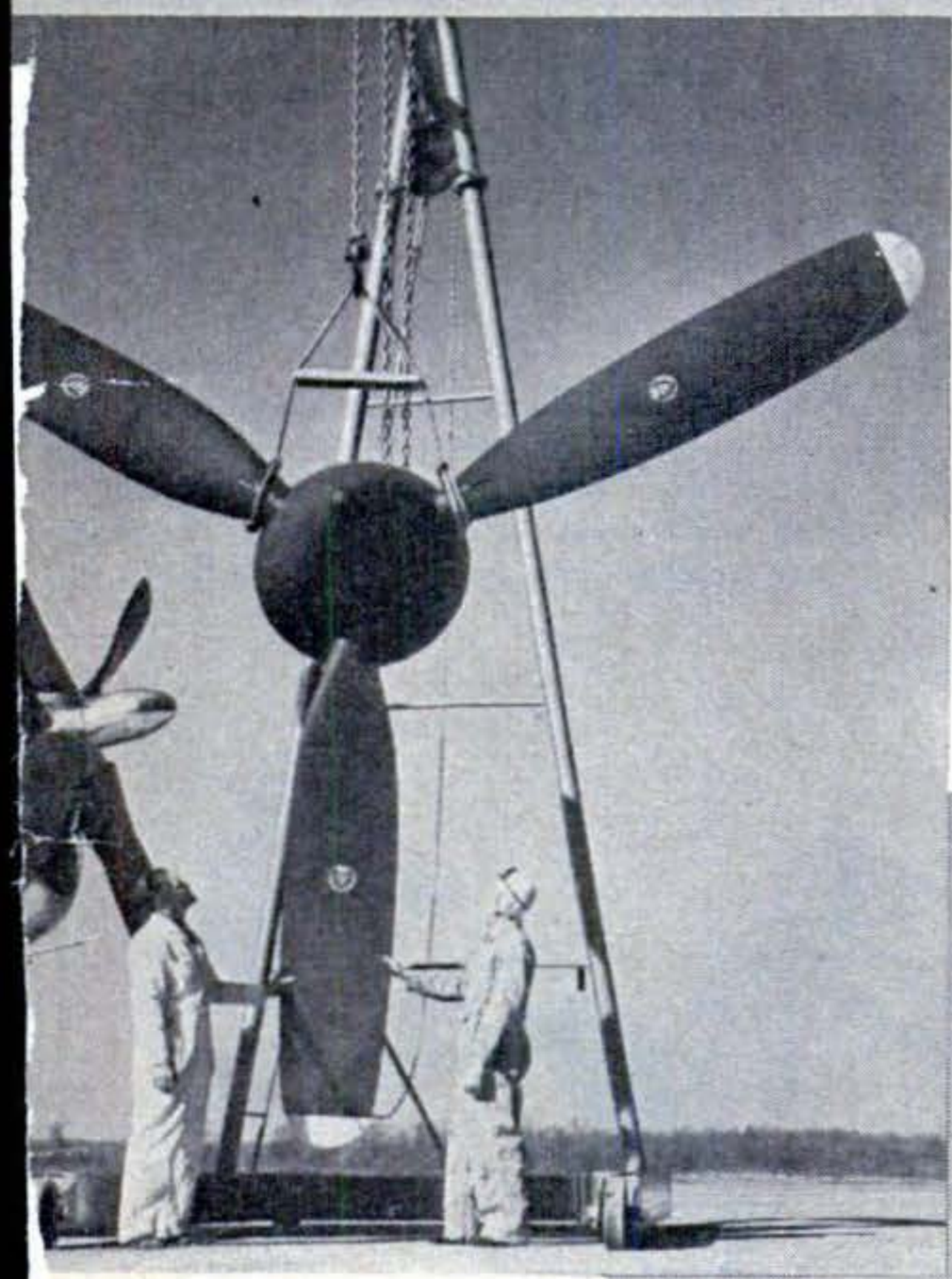


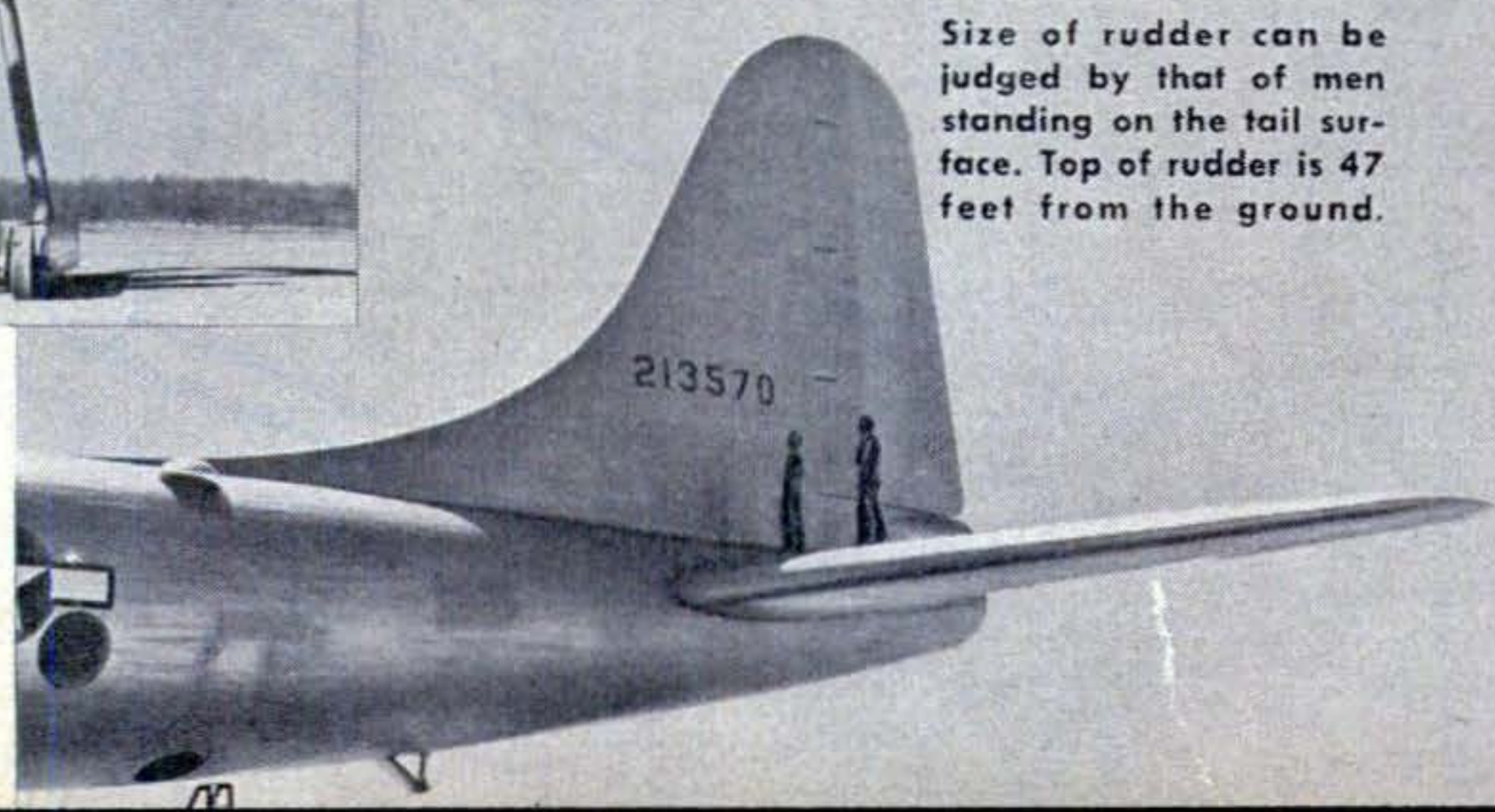
Looking up into the retraction well of one of the two 110-inch wheels. These big wheels will be replaced by eight 56-inch wheels mounted on two trucks.

BETTER B-36 Hits Production Line



The B-36's 19-foot propellers, largest yet, have a thermal anti-icing system. Hot air from the manifold is piped through hollow steel blades.

THE gigantic XB-36, world's largest landplane, has dropped its X. The heretofore experimental bomber is in production at Consolidated Vultee—with improvements made during trials. New landing gear will spread the plane's 140 tons over a wider area and also save 2,600 lb. With reversible-pitch propellers, this will help shorten the landing run, open many more fields to B-36 use. Later, the six 3,000-hp. engines may be replaced by even more powerful types. The B-36's bomb load trebles that of the B-29.



Size of rudder can be judged by that of men standing on the tail surface. Top of rudder is 47 feet from the ground.

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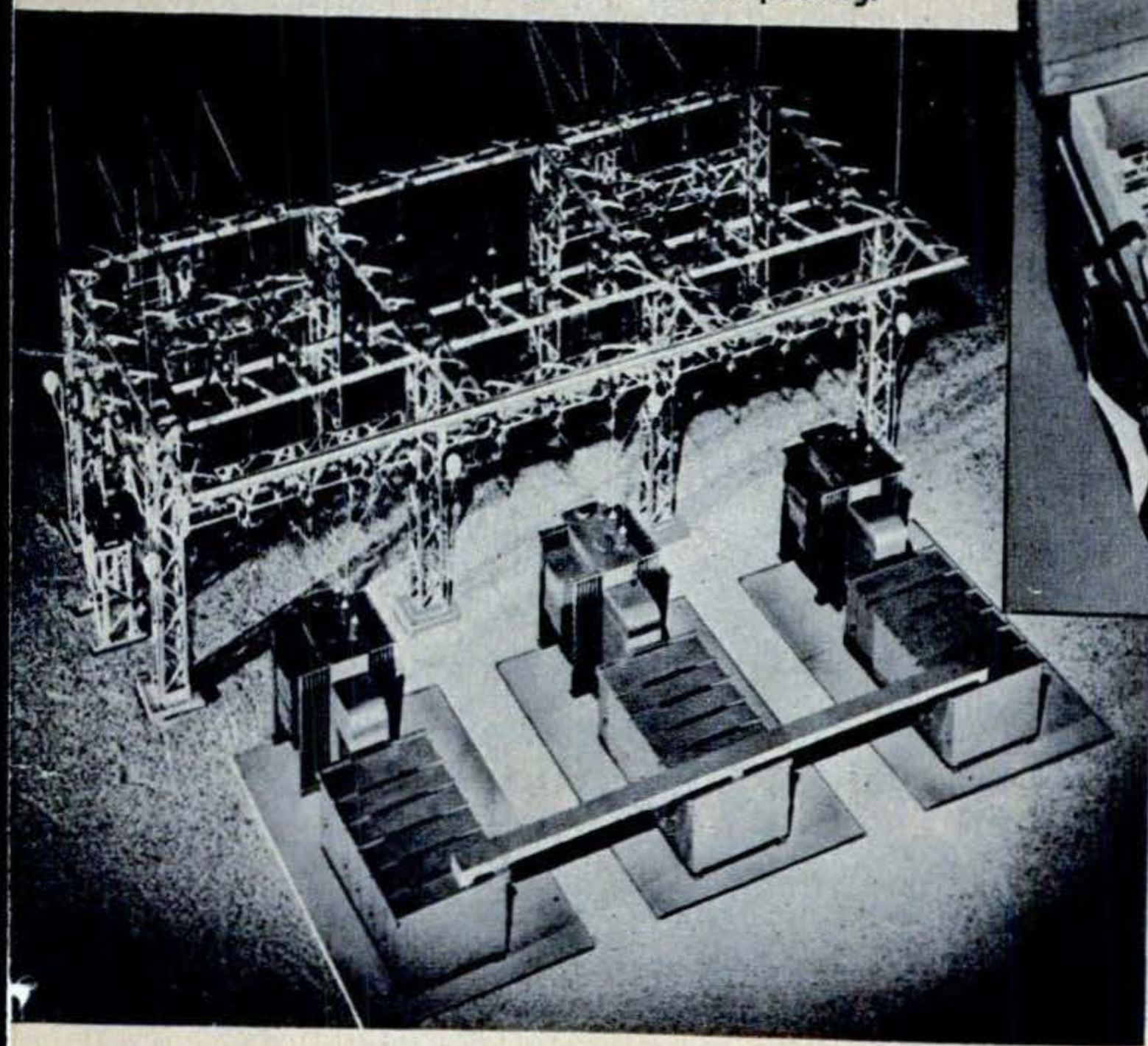
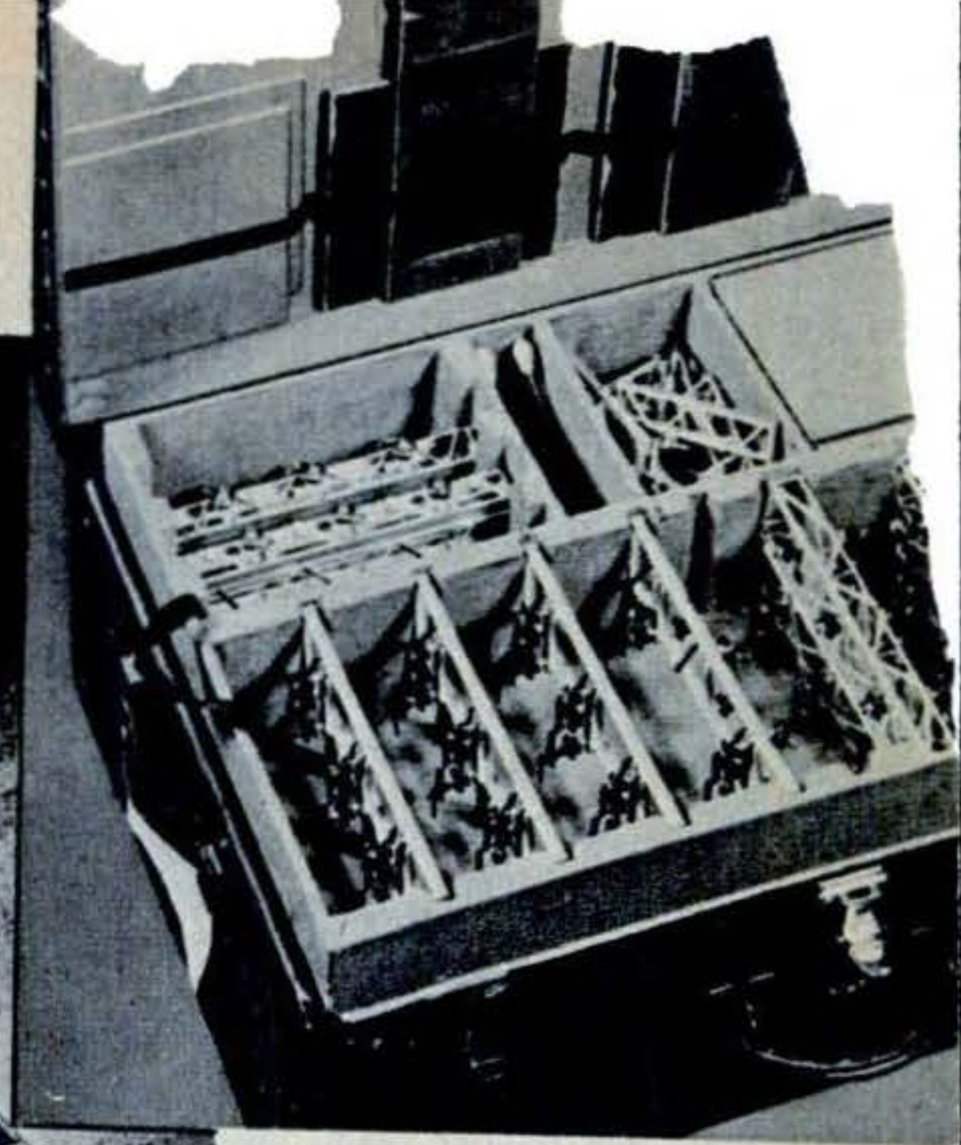
Into the suitcase at right is packed an entire electric substation—Chesebro size. GE builds the big ones and GE's salesmen carry the little ones in their sample cases to show prospective customers. The model comes apart for ease in packing.

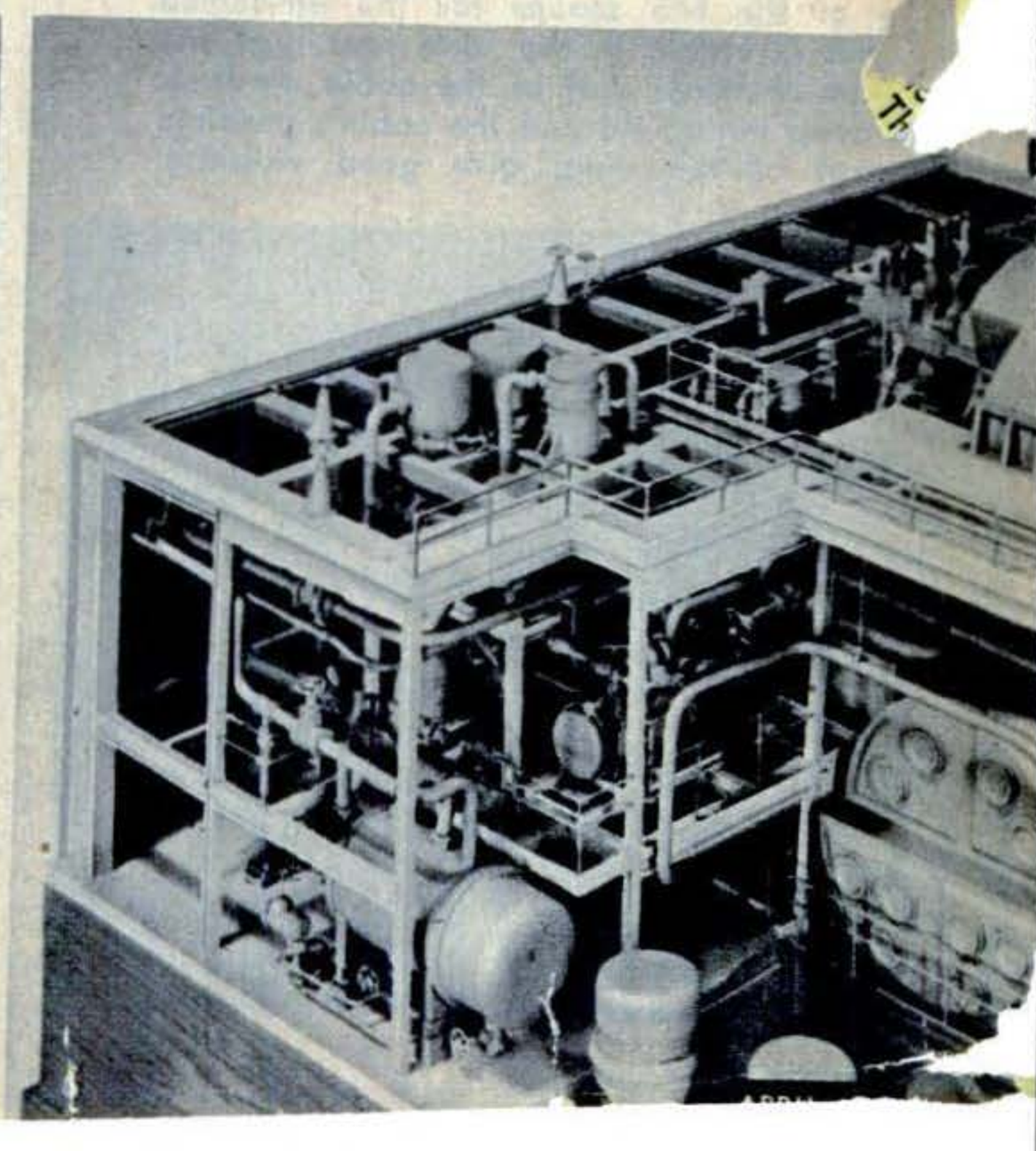




At left is one of the miniature substations set up for display. The transformers and cabinets are made of wood; superstructure rigging and wiring, of brass. The full-size plant, used for multiple subtransmission systems, is a low-voltage selective substation, 9,000-11,700 KVA.

Chesebro was the first person to see what the GE jet engine, built for AAF fighter planes, would actually look like. His model, really a full-size replica (below), was built in secret; the engine parts were locked in a safe every night with the plans. Engine replica was one of Chesebro's favorite jobs in his quarter-century career.

The complicated model below is a turbine room, scaled ½ inch to the foot, built by GE for a large Eastern power company. Chesebro took four months to construct the model, which gave customer an exact picture of the proposed plant and a chanc to correct errors in the design. Wood, brc aluminum, lead and Plexiglas went into it.



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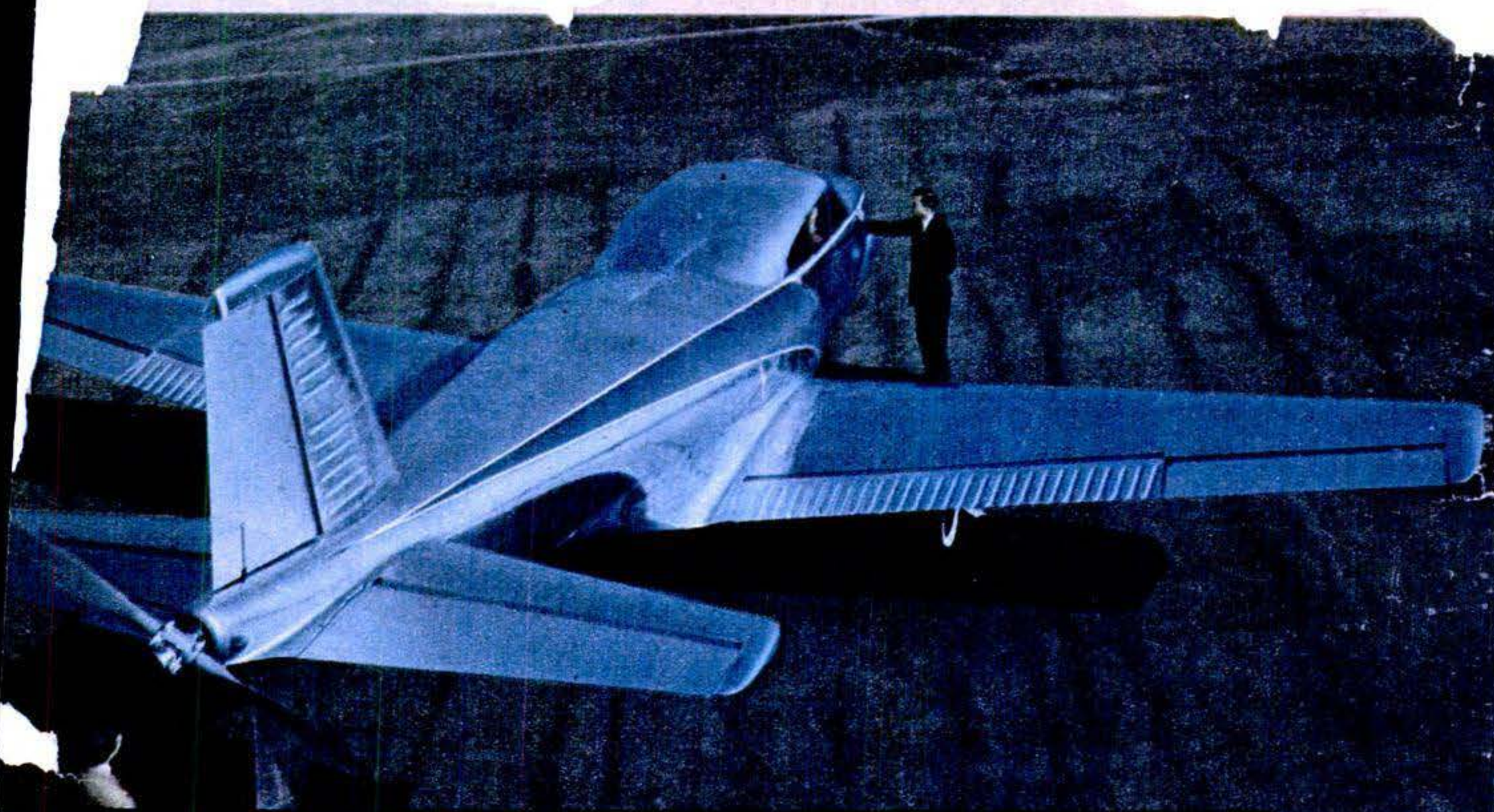

5-PASSENGER PUSHER

A rear view of the new Cloudster discloses an unconventional tail construction, with a vertical stabilizer projecting below the fuselage, as well as one above it. The plane is 35 feet long, has a wing span of 40 feet.

One of the two scoops for the air-cooled engines is visible in the wing root, just below the rearmost part of the cabin windows. The deep windshield and the cabin's position, forward of the wing, give good visibility.

TAKING the XB-42 Mixmaster as a partial pattern, Douglas Aircraft has produced an all-metal, five-passenger, propeller-in-the-tail airplane for executive use or for charter-operated service.

The Cloudster, as it is called, has two 250-hp. Continental engines housed inside the fuselage, and either or both can be used at will without departing from the center-line-thrust principle. Unlike the Mixmaster, which had counter-rotating propellers, the new plane has a single, eight-foot, two-bladed propeller.

With a service ceiling of 11,800 feet on one engine and 22,200 feet on both, the Cloudster carries its five passengers and 250 pounds of baggage 950 miles at 200 m.p.h. and has a maximum range exceeding 1,100 miles. The passenger compartment, forward of the low wing, affords extremely wide visibility; it seats two forward and three in the rear. The craft has retractable landing gear, with a steerable nose wheel for easy ground handling.

No price has been set for the plane, and Douglas says that no production plans will be made until it has completed an exhaustive flight-test program.

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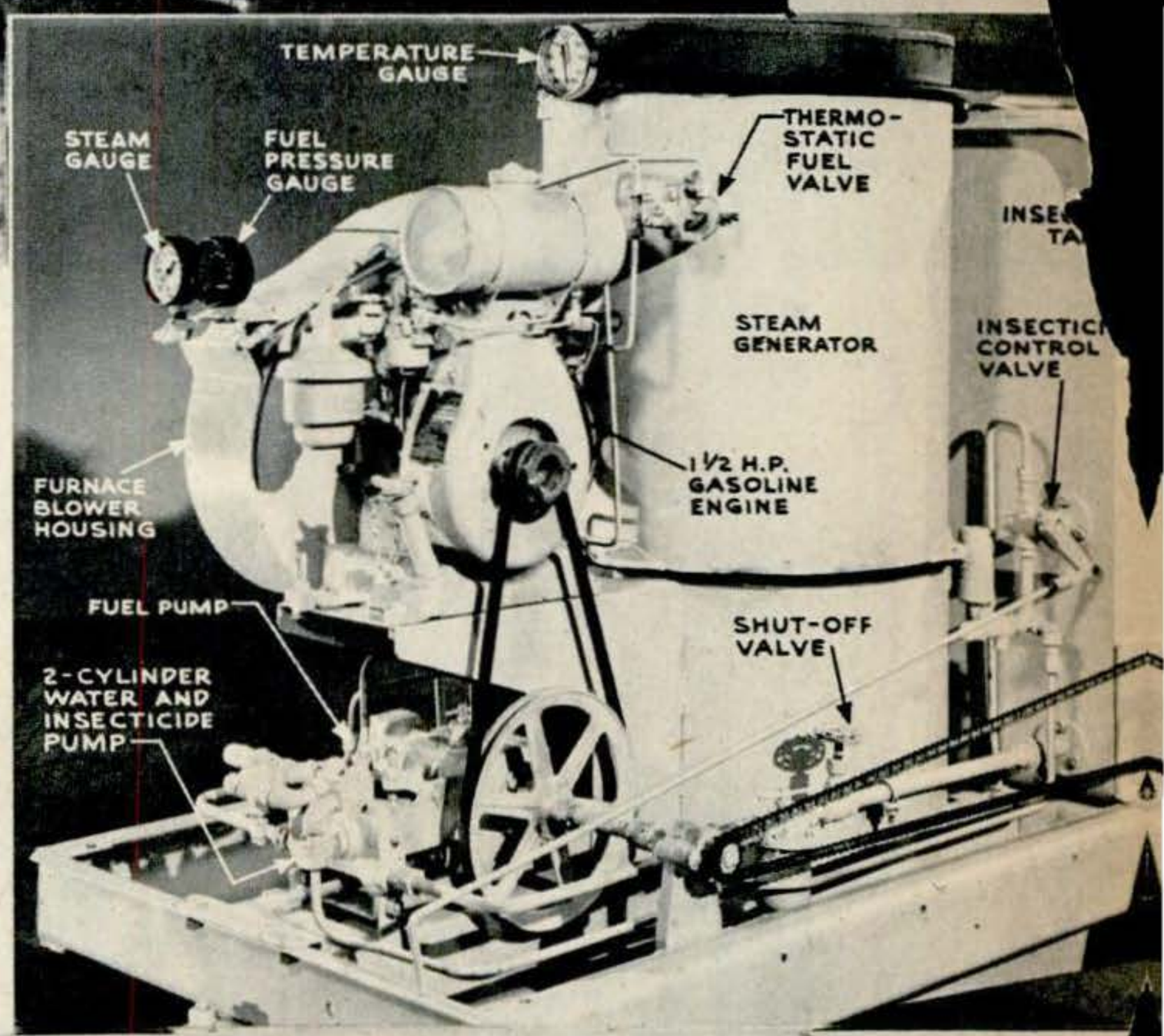

Army Chemical Corps experts, above, inspect an M2 fog maker preparatory to a demonstration at Edgewood Arsenal, where it exterminated beetles with DDT. The converted M2 is mounted on an Army Weasel, but could be carried on a small truck or jeep.

Commercial machine at right is similar in principle to converted M2s. Both use insecticides more efficiently than ordinary spraying methods. The foggers can delouse livestock, apply hormones to orchards, and treat sick trees.

AD-1 PACKS TERRIFIC PUNCH. An airborne arsenal is the best description of the Navy's new AD-1 Skyraider. Built by Douglas, the attack plane is primed for action with 5-inch and 12-inch (in red) "Tiny Tim" rockets.

FILM IS TRUE TO COLORS. Fidelity to basic colors h a wide range of light intensity is achieved with the new rome color film made by Eastman. The film permits much flexibility in lighting colored subjects, as indicated in the panying photograph, and thus produces more dramatic and e results. The film can be developed in less than two hours, y photographers who normally work only in black and white.

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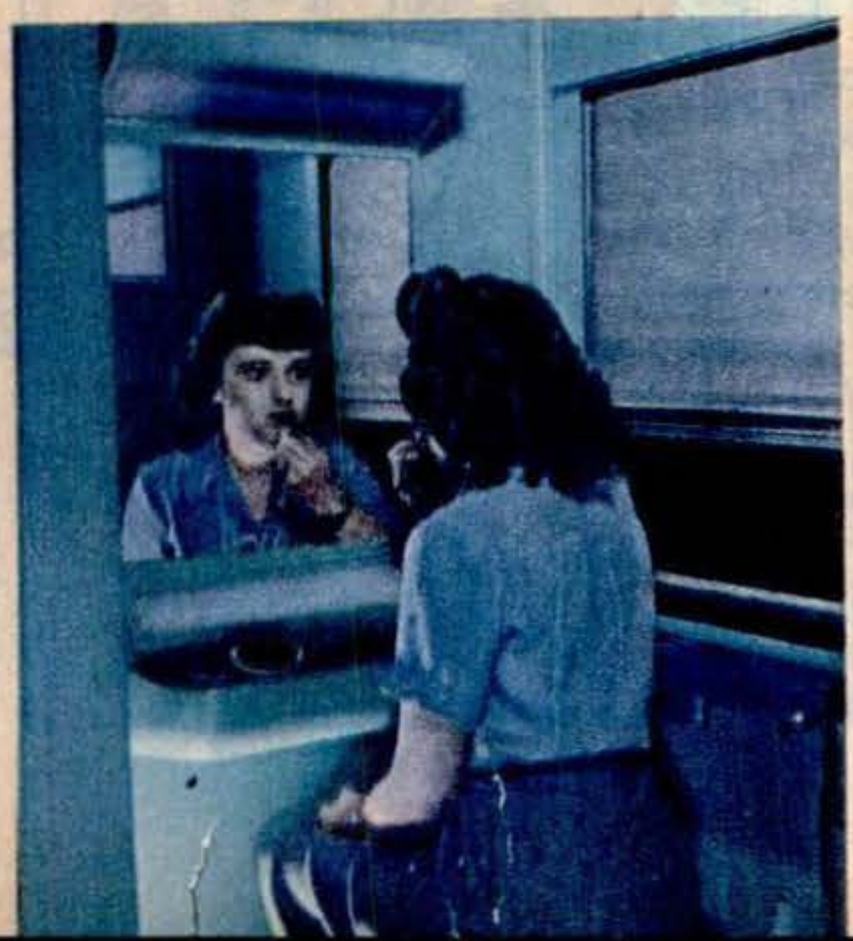
At right: Roomy master drawing room that provides beds for four and daytime space for six can be formed by folding back a wall that normally separates two adjacent double bedrooms. Below: Interior view of a new double bedroom shows the enclosed toilet and lavatory that doubles as a stall shower. Chair in foreground is movable.

Newest Trains Stress Low-Cost Luxury

At right: A mockup of the latest thing in coaches shows the full-reclining chairs, modern lighting and attractive upholstery that outdo the comfort of present-day chair cars. Below: The new coaches' washrooms are divided into cubicles that can be curtained off for privacy. Thus coach passengers will be able to change their clothes during long trips.



AMERICA'S railroads are out to get your business. To get it, they are spending an estimated $1,600,000,000 for revolutionary postwar trains with super-deluxe accommodations. Far beyond drafting-board dreams are such things as theater cars for evening movies and stage shows, playroom cars where your children can romp under the watchful eyes of trained attendants, special double-deck observation cars, and coaches with radiant heating, heated windows, automatic entrance doors, radios and public-address systems. Already rolling

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from the car builders' assembly lines (PSM, Feb. '47, p. 121) are new streamlined coaches with better than chair-car conveniences, sleeping cars with spacious double bedrooms offering all the basic comforts of your own home, and other cars with comfortable low-cost private sleeping rooms designed to replace the present uppers and lowers. The railroads are doing their best to make your future trips, business or vacation, hit a new high in travel comfort.

When you ride in one of the newer postwar coaches, you will have a full-reclining chair with an adjustable leg rest and plenty of room for your knees. A choice of private radio programs will be at your fingertips by way of a four-position switch in your armrest and a tiny loudspeaker built into your comfortable headrest. You and your neighbor will be able to enjoy entirely different programs.

You will enjoy air conditioning, soft fluorescent lighting, broad panoramic windows, large lounges and washrooms, carpeted floors, soundproofed walls and ceilings, and colorful, restful interiors. Your car will be manned by an attendant; if you need them, you will find that a trained nurse and a passenger-service agent are part of the train crew. Your car attendant will not have to leave the car to talk to the engineer, to the diner, or to any other car. He will simply pick up a telephone in the vestibule and plug into the train's communication system.

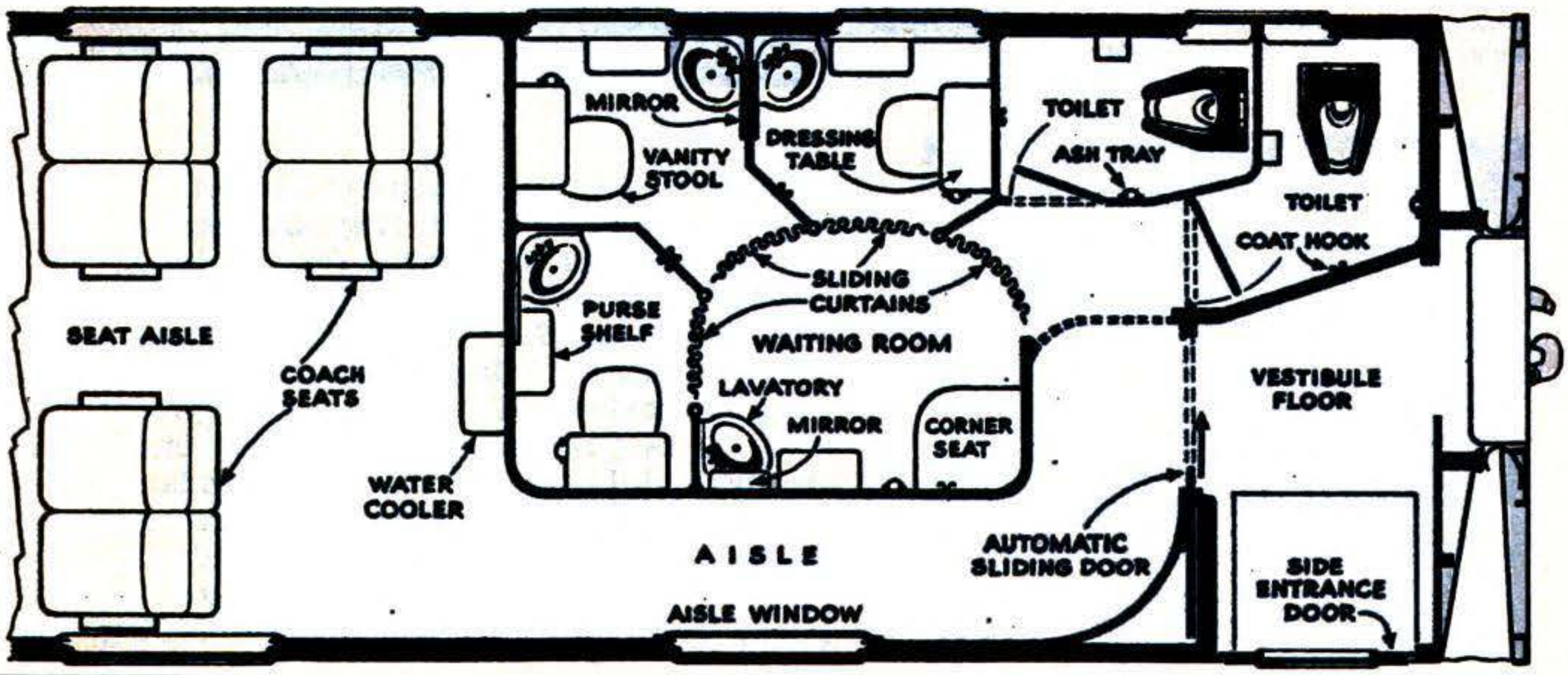
As you walk through this train of the not-too-distant future, there will be no battling with heavy car doors. Merely moving the door handle will start an automatic mechanism that slides the door open, waits for you to pass, and then closes it again. If you have lots of luggage and are a trifle slow, a sensitive rubber bumper reverses the mechanism the moment the door's edge touches you and opens it again. By flicking a switch, the door can be opened and closed by hand if desired. A new type of vestibule door has also been designed.

A premade bed in one of the double bedrooms can be lowered by unlatching it and letting it slide down tracks. Latch pole becomes a support.

Brand new sleeping cars in a variety of designs and combinations are about to roll from assembly lines. Typical of the cars being produced by the nation's car builders are the three types being manufactured by the Budd Company, makers of stainless steel railroad cars.

In the postwar overnight trains, drafty, curtained upper and lower berths are out. Instead, you will find the "budgette" car that offers complete individual privacy to 32 passengers. By a skillful juggling of the space in a standard sleeping car—stagger-

Privacy and comfort are the chief features of new coach washrooms. Diagram of women's room shows arrangement of cubicles and improved conveniences. Men's room has a similar arrangement.



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ing the rooms in pairs so that one pair is at aisle level while the next is raised—each "budgette" is large enough for a full-size premade bed that can be put into place or stowed easily either by the passenger or the porter.

Next in the scale of comfort and price is a new single bedroom called a "cabin." It provides a premade six-foot-four-inch bed that you can lower into place or stow in the rear wall without leaving the room. Even with the bed down there is ample space to undress. Closing the berth brings a wide, adjustable, three-position chair into use. Each room has individual air-conditioning, temperature and light controls.

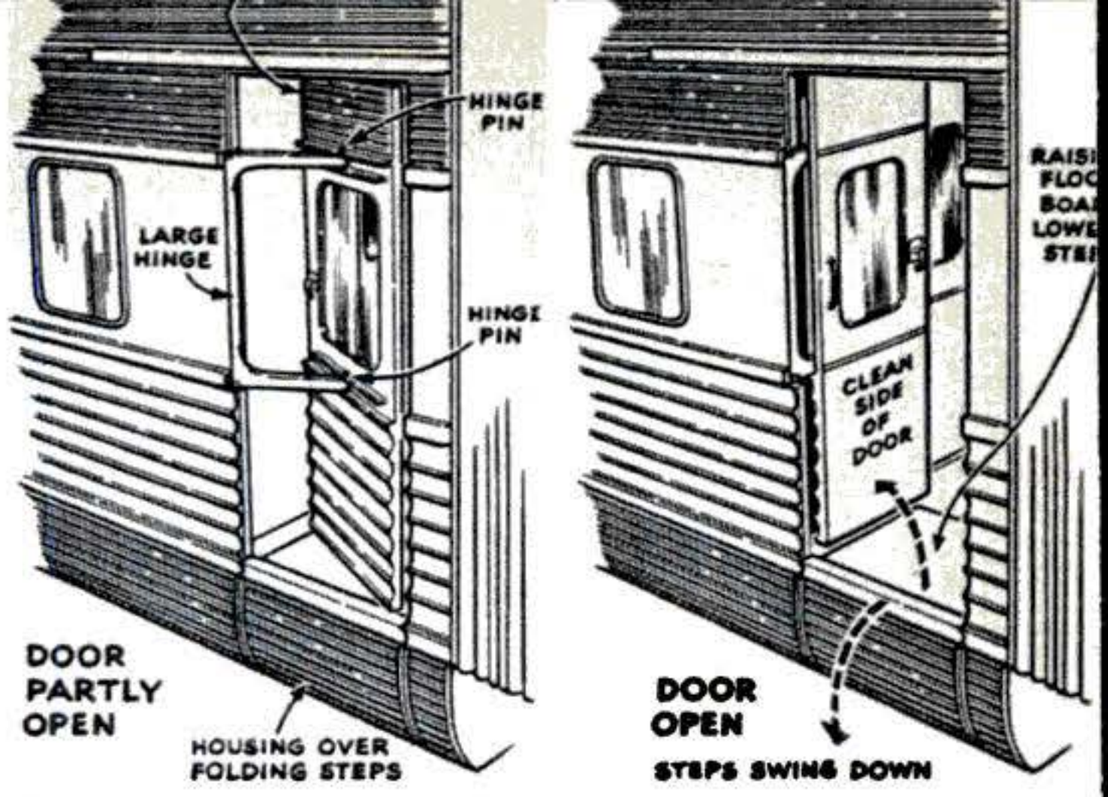
For two people, or one person who wants lots of room, the postwar train offers something new in double bedrooms. Besides comfortable beds with foam-rubber mattresses, and wide seats for daytime use, these rooms have full-length clothes closets, more than normal baggage storage space, and a completely enclosed toilet and lavatory that doubles as a stall shower.

Opening a folding wall that separates two adjacent rooms forms a master drawing room. The combination provides a luxurious travel apartment with four beds, seats for six, two enclosed toilets and washrooms, and two roomy wardrobes. The two 45-inch windows combine to give a 7½-foot panorama of the scenery.

More sleeping comfort for those who travel in coaches also is on the way. Besides the comfortable full-reclining chairs that already are in production, car builders plan to install new washroom lounges for men and women.

This new comfort the railroads are striving to give you in postwar trains is by no means limited to accommodations. The new rolling stock incorporates a good many mechanical wrinkles designed to give you a smoother, safer ride. One innovation—an air spring for passenger-car trucks—is now being tested jointly by the Firestone Tire and Rubber Company and the Pullman-Standard Manufacturing Company. The new air spring is like a small automobile tire, lying on its side and mounted in the truck. Filled with air at 75 lb. per square inch, it is connected to an air reservoir that acts as both spring and shock absorber. When a wheel hits a bump in the track, air is forced into the reservoir. The rebound is then snubbed by a special control valve that prevents the air from flowing back into the bellows too quickly.

Testing plays an important part in the development work of the railroad car builder. Nothing is too minor, not even a small door handle, to escape the test engineer's torture chamber. The production of



Vestibule doors with center hinges will always keep the clean side of door toward passengers, protecting clothing, and will increase luggage space.

a new type of car is not a matter of one jump from the drafting board to the assembly line. Once a general design has been approved, the plans go to the mockup department where a crew of carpenters build a full-size wooden mockup complete with interior fittings. For weeks and months, engineers and designers fuss with it, making changes here and additions there. Finally, when the wooden model seems about right, a complete steel model is made by hand. Even after that, changes are made.

While this has been going on, test engineers have been busy making sure that the mechanical things, like the reclining chairs, sliding berths and concealed wash basins, not only will work as the designers planned but will stand up under continuous use. In testing a berth, they even go so far as to "tune" the metal frame of a master model to make sure that there will be no rattles, rumbles or squeaks in the final production-line job. An electric motor attached to an eccentric arm jounces and jiggles the frame day after day while workmen improve it.

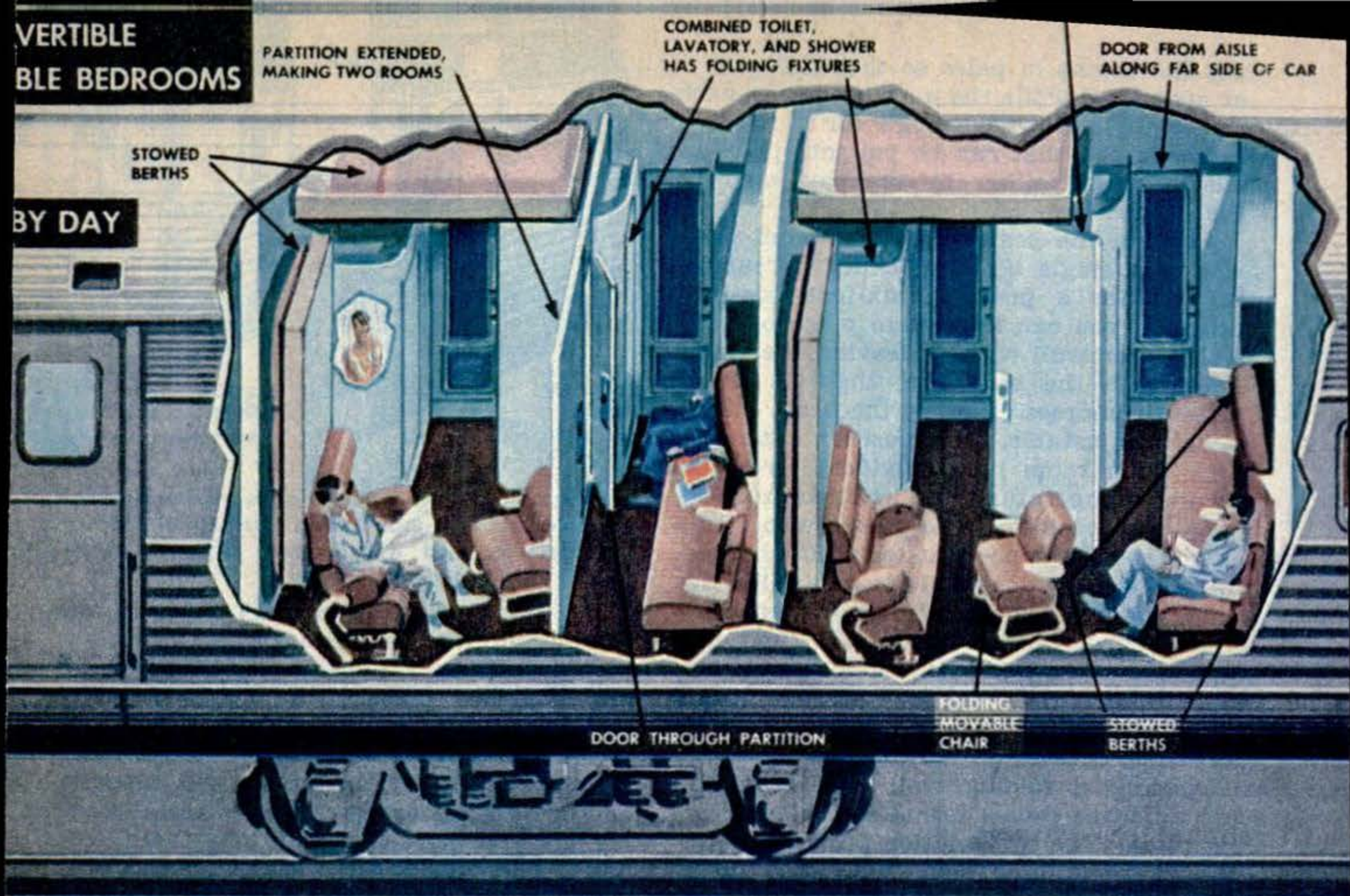
On another machine, a tricky disappearing berth that requires springs and pulleys is life-tested. Opened and closed at two-minute intervals, it gets the equivalent of five years of wear in 125 hours.

New types of heating arrangements and air-conditioning systems are put through their paces. Trucks are checked. New types of soundproofing and insulating materials are tried. Before a new car design is even tested on the road, it gets a scientific third degree from coupler to coupler.

Yes, the railroads are going all out for your business. Materials and production problems are holding up the new equipment parade at the moment, but it is safe to say that if you travel you will be riding in some of these new cars by the end of the year—and that you will find new comfort and safety in railroading.

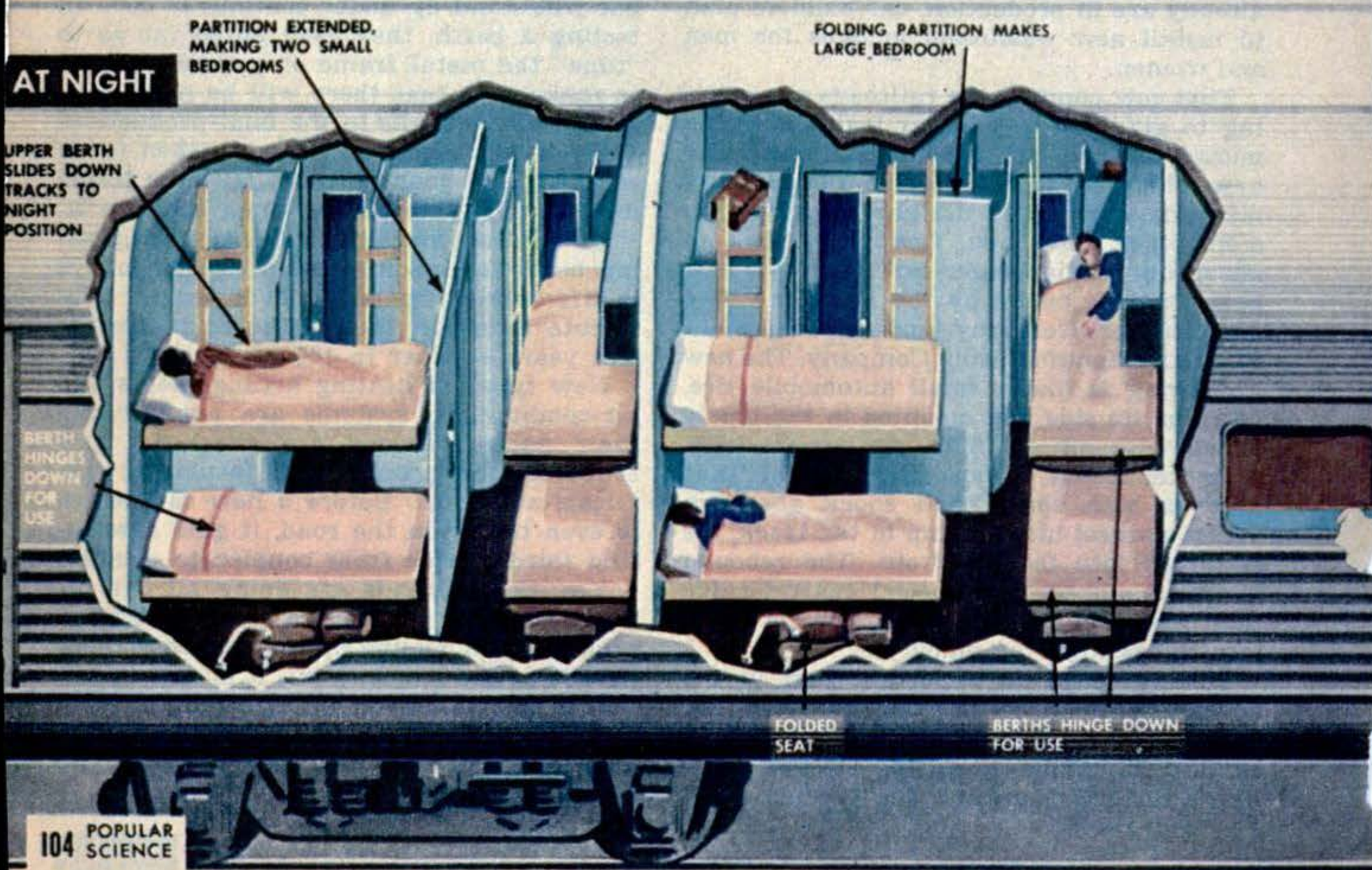
VERTIBLE BLE BEDROOMS

BY DAY



Railroads found that fore-and-aft and crosswise berths are about equally popular. Cutaways show how double bedrooms alternate between the two types, or provide both in a ma.ter drawing room.

AT NIGHT



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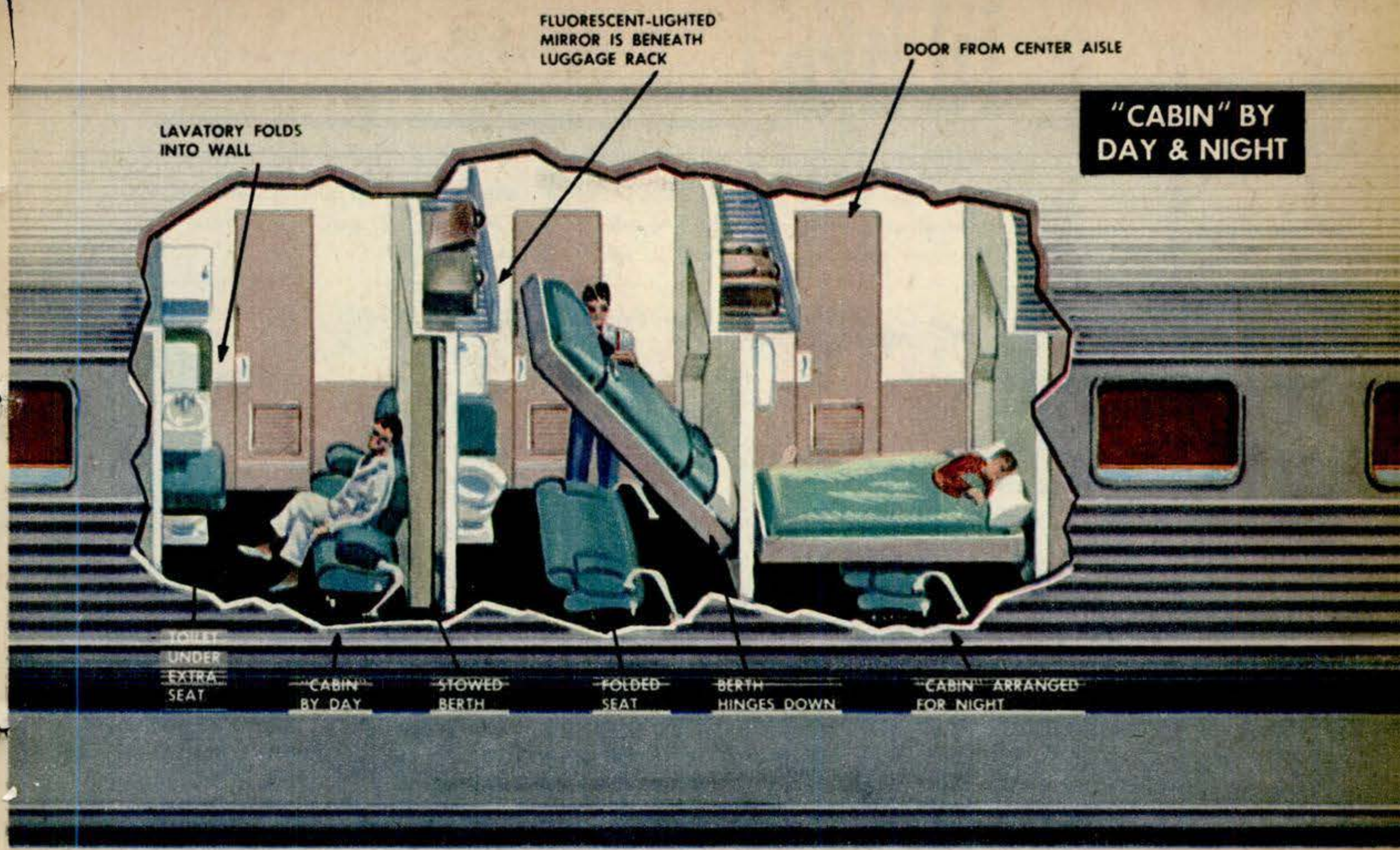
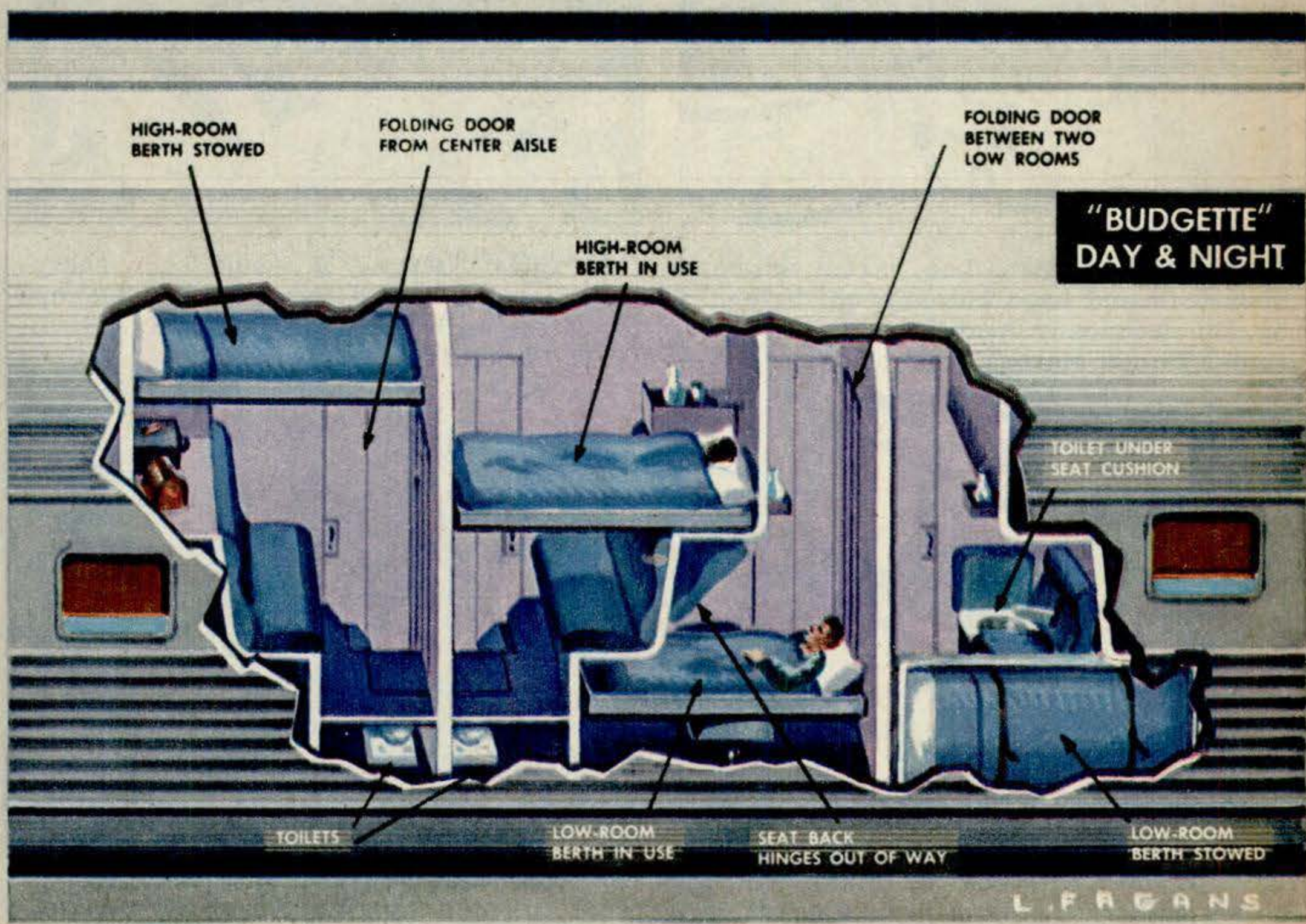


Cabin cars resemble prewar "roomettes," but are improved. "Budgette" offers single bedrooms for about the price of a lower berth. Two bedrooms adjoining on same level can be thrown together.



I'd like to see them make

Cartoons by
SYD LANDI

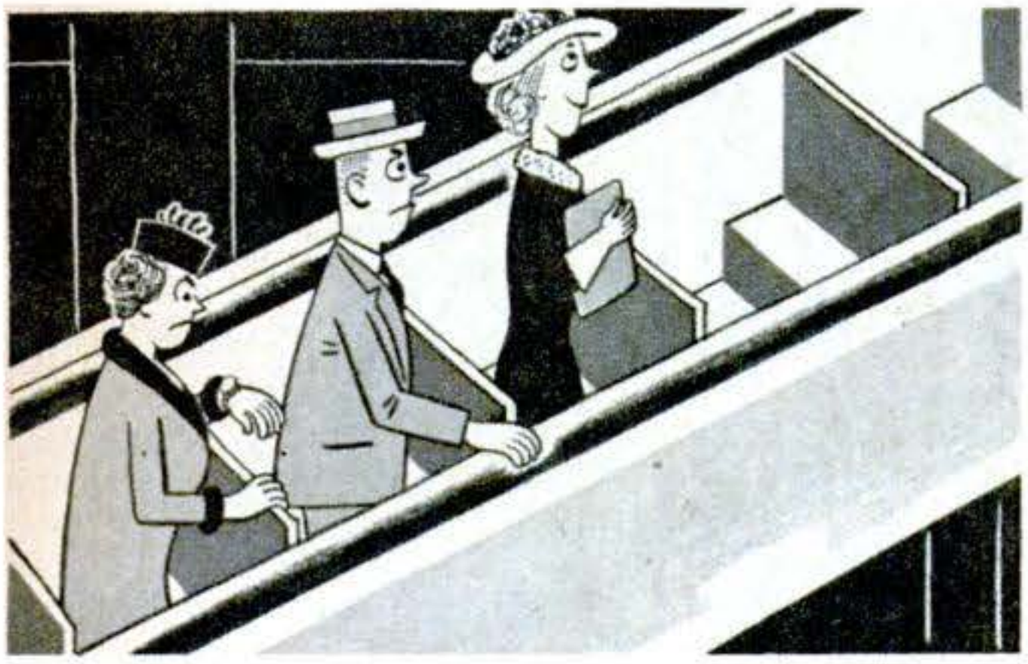
Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish.

A Pointless Umbrella. To guard the eyes of the public, R. G. Walsh, of Boston, recommends a bumbershoot without those treacherous, protruding rib ends.

Magnets to Save Tires. For more driving safety and pleasure, William Montalto, of Watertown, Mass., suggests bumper magnets that will pick up tacks and nails.

Butter-Tamer. The battle between housewife and hard butter could be ended by an electrically heated butter spreader, thinks Daniel Marcus, of Brooklyn.

Allergic Saws. It would be a sharp idea to equip saws with an electric hookup to detect nails ahead and sound a bell, W. C. Peck, of Seattle, believes.



Escalator Booths. So impatient persons can't crowd a rider into climbing, Doris Kenney, of Wollaston, Mass., wants a spring device for separating escalator steps.

Adjustable Theater Seats. Copy the barber chair and build theater seats that can be raised when people in front cut off the view, urges Michael Dunn, of Milwaukee.

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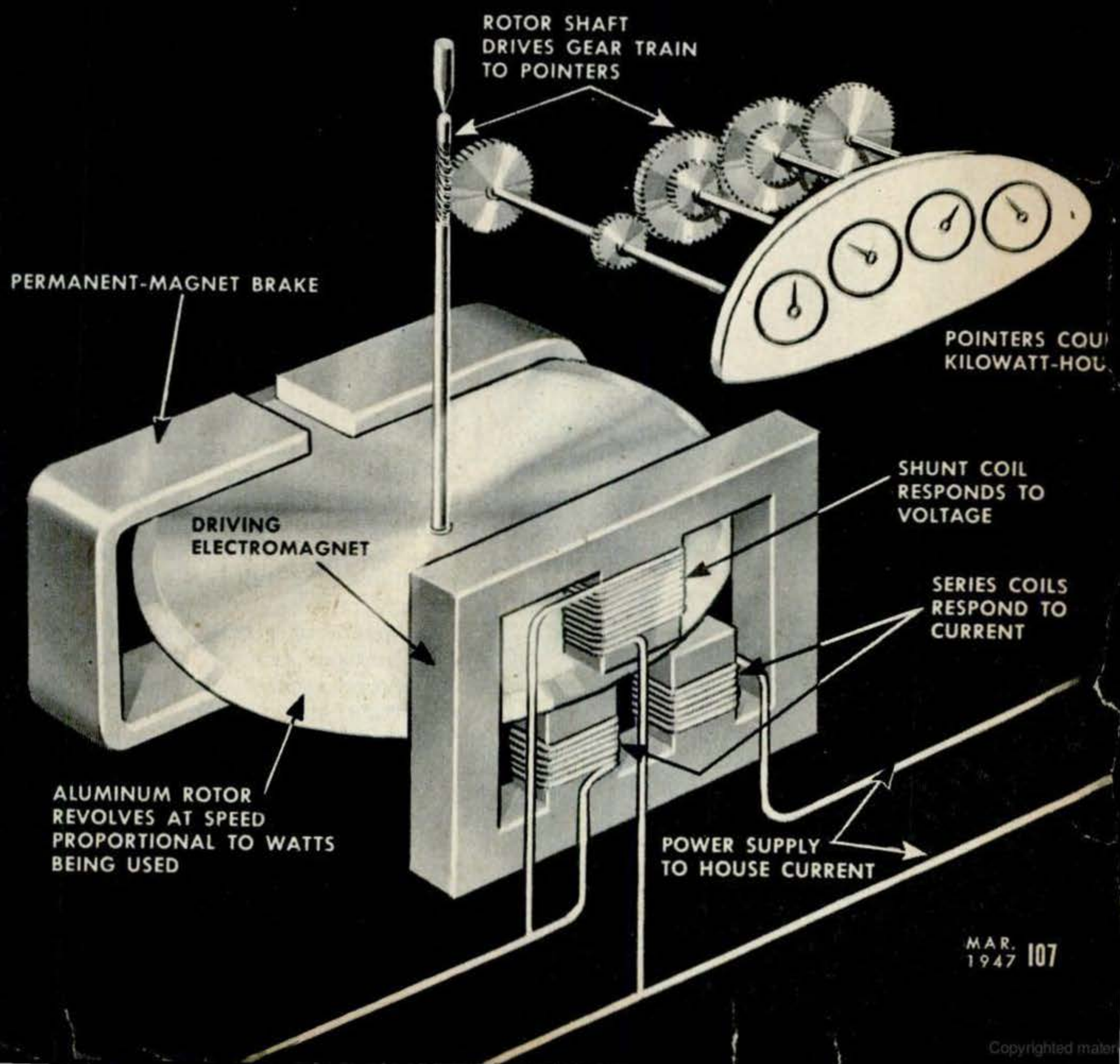
HOW Electric Meters WORK

YOU pay for electricity by the kilowatt-hour, a unit of energy that serves as a handy common denominator for light, heat and power. By showing the total directly, your meter side-steps the calculation that kilowatt-hours equal watts (volts times amperes), multiplied by hours of use, and divided by 1,000. Basically an electric motor, the familiar alternating-current type of meter shown below has two kinds of driving coils. One, by-passing house wiring, responds to volts; the other, through which all current reaches the consumer, to amperes. By induction, the magnetic coils set up electric currents in the rotor, a disk of solid aluminum. Their combined effect, plus that of a permanent magnet acting as a brake, rotates the disk at a speed exactly proportional to the wattage of all lights and appliances being used.

Therefore the amount of energy you consume, which depends upon how long you draw power from the lines at any given rate, is registered simply by counting the number of revolutions of the rotor. Through worm gearing, its shaft turns pointers that tally the kilowatt-hours by ones, tens, hundreds, and thousands. Subtracting the previous reading of the meter from the present one gives the quantity for which you get a bill. There is no charge for the slight amount required to run the meter itself.



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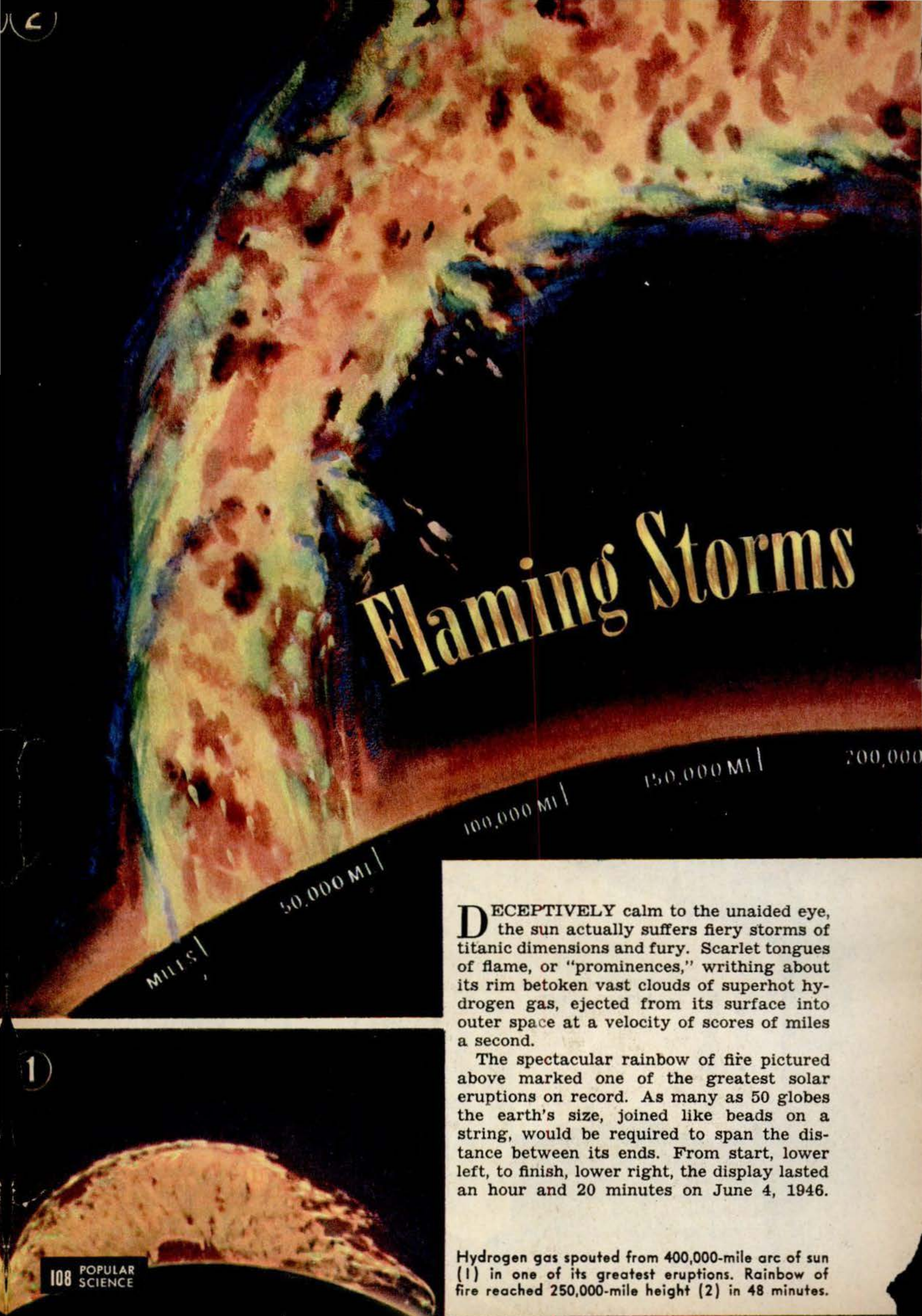
Flaming Storms



DECEPTIVELY calm to the unaided eye, the sun actually suffers fiery storms of titanic dimensions and fury. Scarlet tongues of flame, or "prominences," writhing about its rim betoken vast clouds of superhot hydrogen gas, ejected from its surface into outer space at a velocity of scores of miles a second.

The spectacular rainbow of fire pictured above marked one of the greatest solar eruptions on record. As many as 50 globes the earth's size, joined like beads on a string, would be required to span the distance between its ends. From start, lower left, to finish, lower right, the display lasted an hour and 20 minutes on June 4, 1946.

Hydrogen gas spouted from 400,000-mile arc of sun (1) in one of its greatest eruptions. Rainbow of fire reached 250,000-mile height (2) in 48 minutes.

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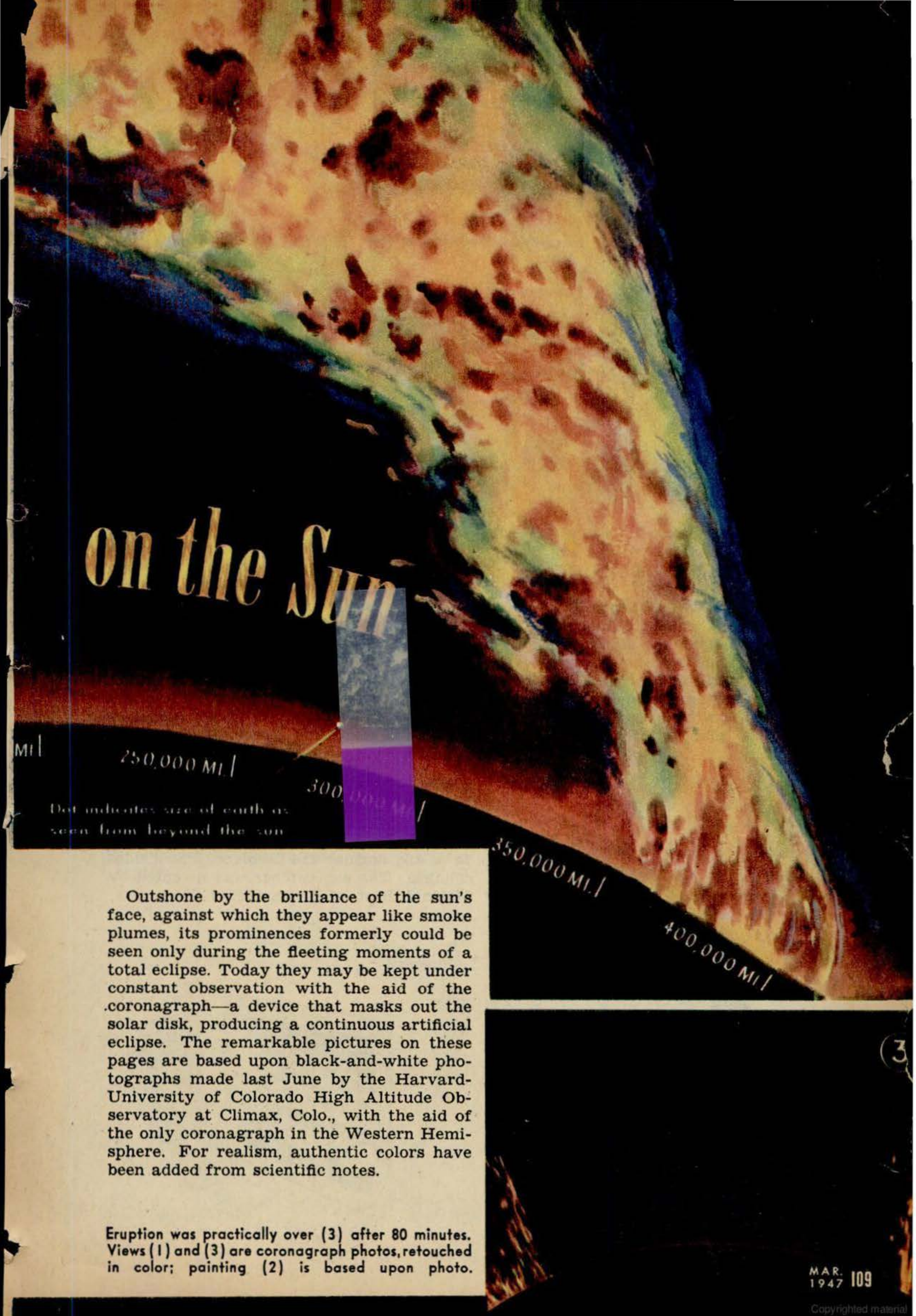
on the Sun



Outshone by the brilliance of the sun's face, against which they appear like smoke plumes, its prominences formerly could be seen only during the fleeting moments of a total eclipse. Today they may be kept under constant observation with the aid of the coronagraph—a device that masks out the solar disk, producing a continuous artificial eclipse. The remarkable pictures on these pages are based upon black-and-white photographs made last June by the Harvard-University of Colorado High Altitude Observatory at Climax, Colo., with the aid of the only coronagraph in the Western Hemisphere. For realism, authentic colors have been added from scientific notes.

Eruption was practically over (3) after 80 minutes. Views (1) and (3) are coronagraph photos, retouched in color; painting (2) is based upon photo.

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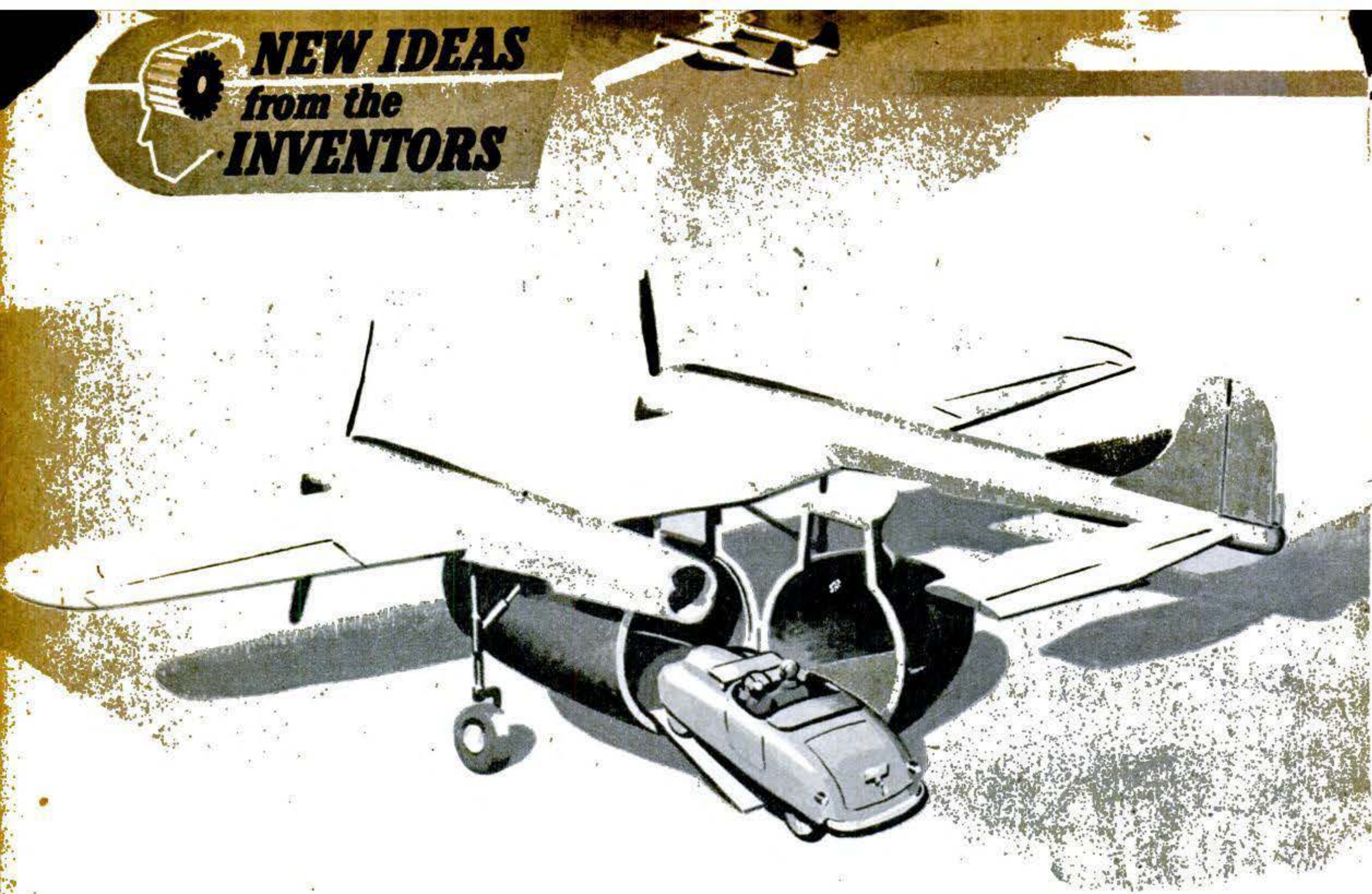
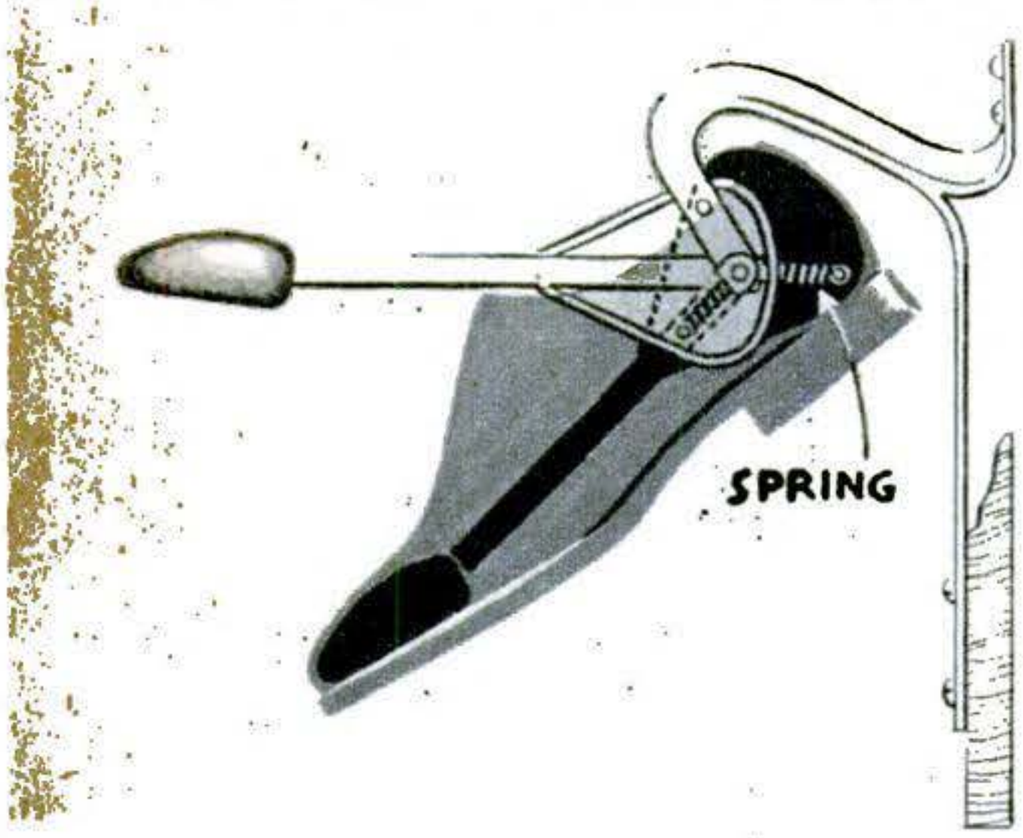
NEW IDEAS from the INVENTORS

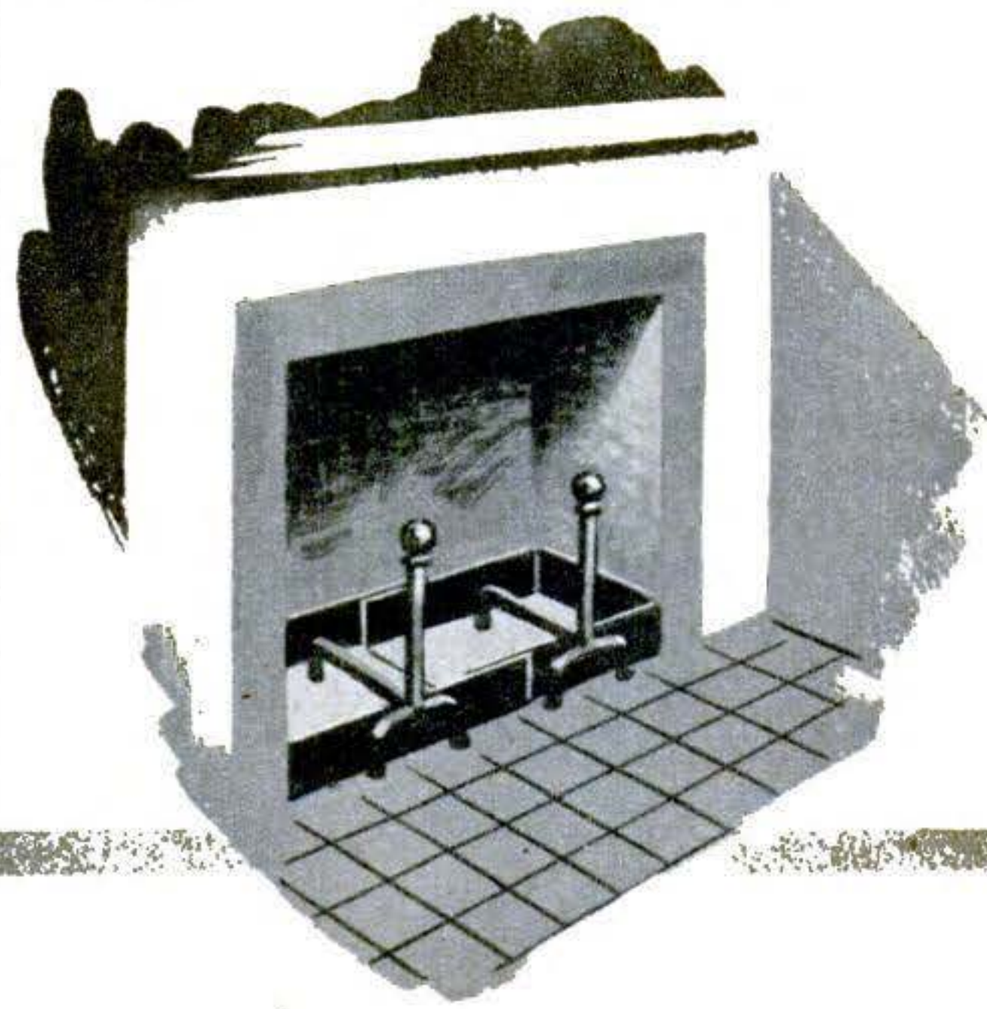


Air-Land Combination. Departing from the idea of a single machine that either flies or runs on the ground, the automobile-airplane set shown above consists of two self-sufficient units—a conventional two-engine airplane and an automobile—fitted to work in combination. The car enters the plane's fuselage on ramps and is attached to the floor of the compartment by struts and wheel chocks. The plane's foot-pedal controls enter the car through an opening in its front. The pilot's wheel extends down from overhead into the front seat. Thus the car becomes the pilot's cockpit. The combination was invented by Robert C. Read and Ernest E. Schlieben.



Wall Shoetree. In addition to holding shoes for shining, the shoetree above can be utilized as a space-saving rack for extra footwear by attaching it to closet walls. It was designed by R. C. Magee, of Dayton, Ohio.

Universal Fireplace Pan. The bottom of ashpan shown in fireplace below consists of two metal panels, one overlapping the other to allow pan to be adjusted to fit any normal-size fireplace. Pan's sides collapse. The ash catcher was invented by Marie J. Best, of Bronxville, N. Y.



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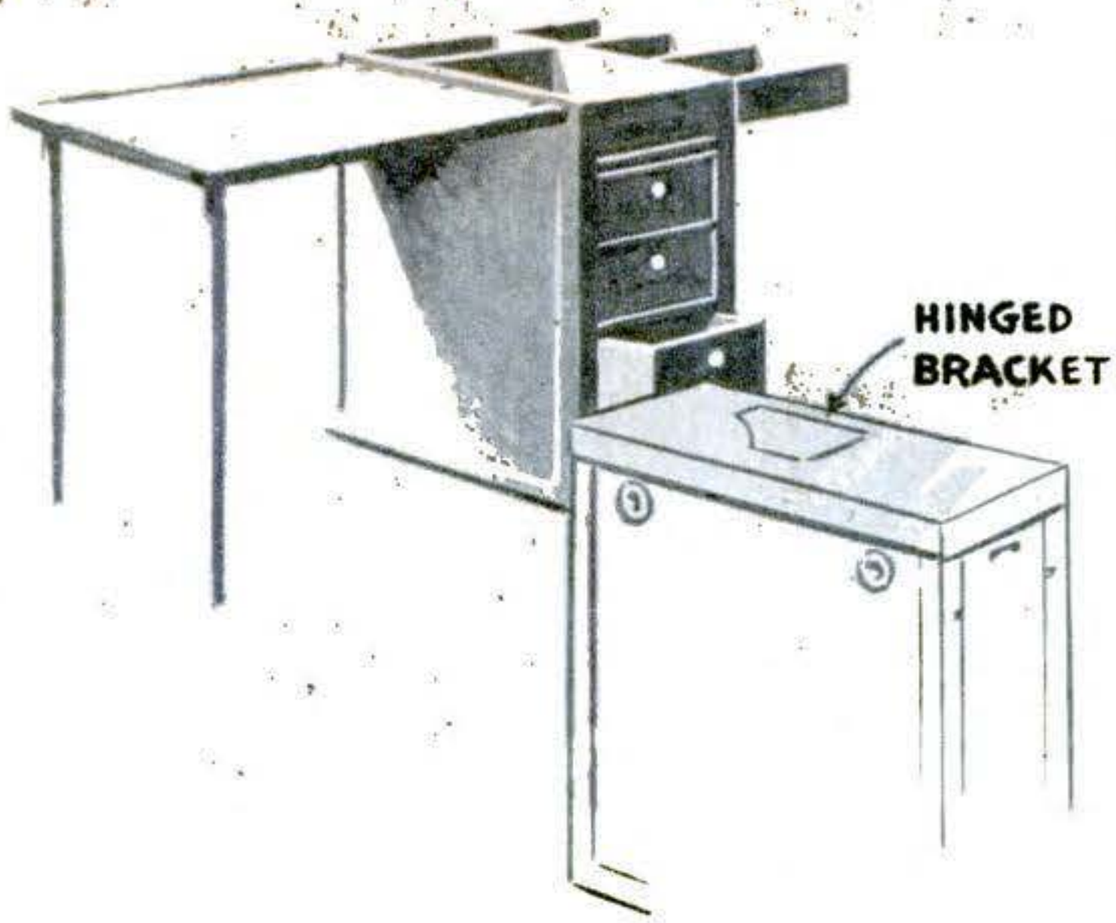
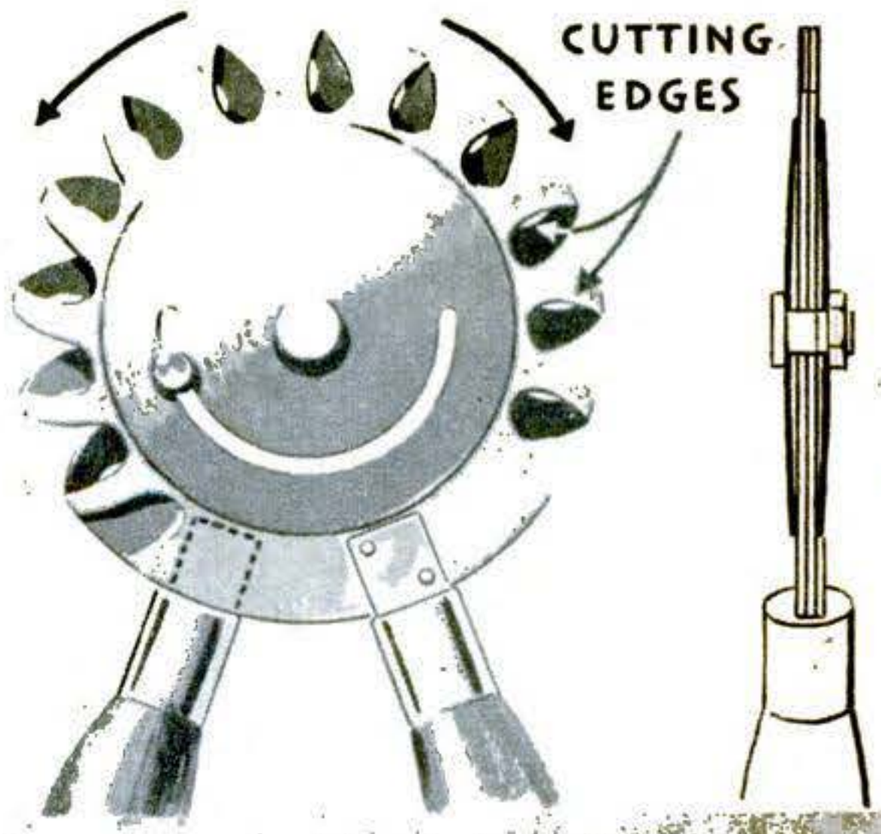
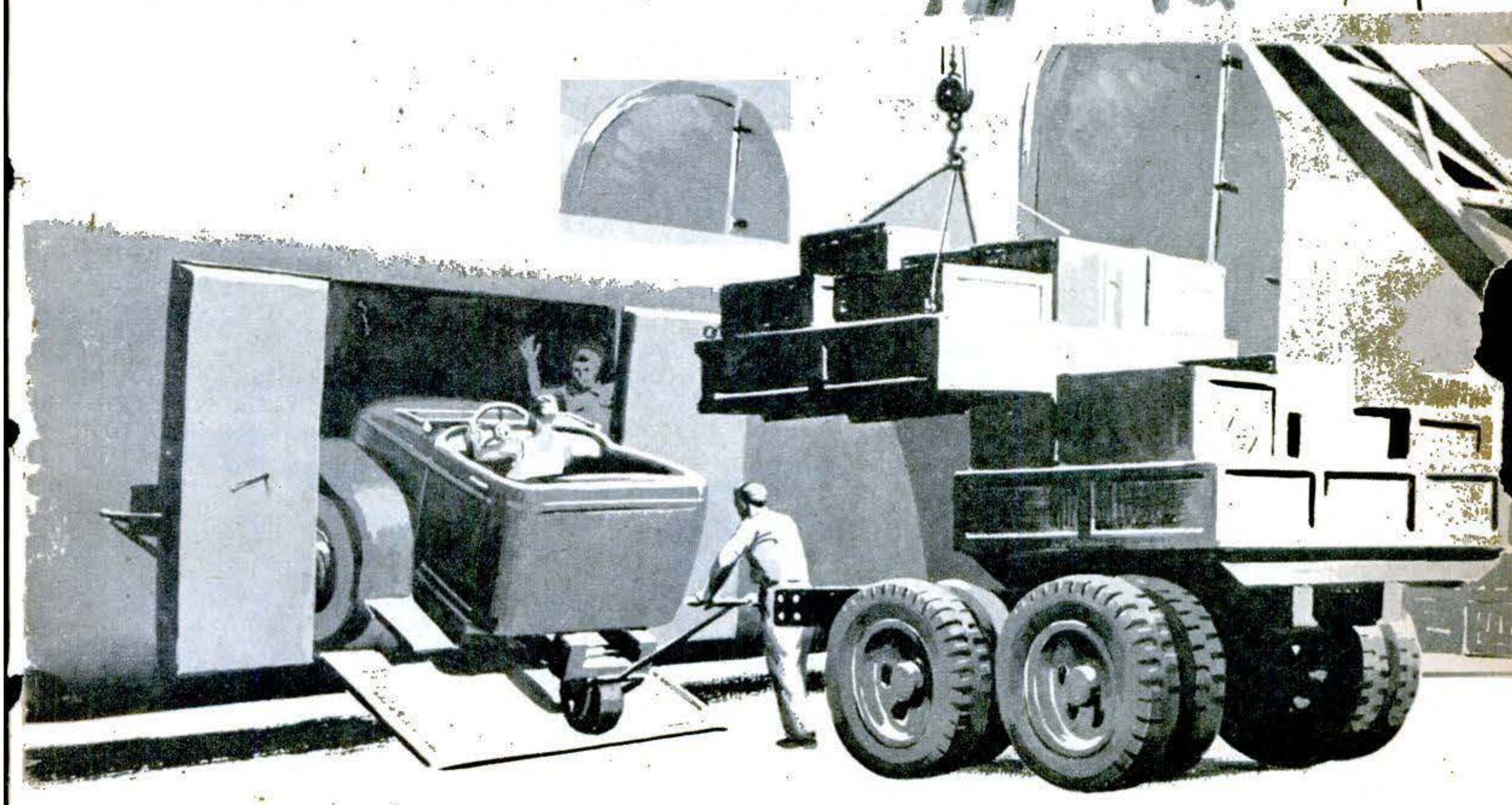


Army Cabinet-Desk. Devised by W. A. Hamberg, of the U. S. Army, for action in the field, the combination cabinet and desk at left unfolds into a table and cabinet with drawers. For moving, the table top fits into the cabinet's side. The bracket on the folded unit supports the top of the cabinet when it is opened to form divided file compartments.



Circular Hedge Cutter. Two disks turn around a common axis to produce a circular cutting action when handles of a hedge cutter, invented by R. H. Beach, of Rockdale, Md., are pressed. The cutting edge of the teeth of one disk incline in the opposite direction from those of the other.



Airborne Cargo Truck. With an eye to military exigencies, inventors Ronald D. Bagley, of Indiana, Pa., and J. E. Berman, of Suffolk, Va., have designed a truck that can be uncoupled and loaded in sections through the relatively small doors of cargo planes for use in regions where trucks are few. Frames of the tractor and carrier sections of the truck are joined by bolted steel braces. When uncoupled, the tractor's rear end rests on a retractable dolly that is steered manually by a handle. This allows the tractor to enter a plane under its own power.

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WHO'S WHO *in the Sky*

LIKE the house flags of clipper ships, distinctive insignia mark today's air liners. Here are the flying emblems of U.S. air lines using four-engine planes.

United has used a shield since 1934. Wings are added when it is printed over a long stripe.

Chicago and Southern recently revamped design and colors of its emblem. Here's the result.

American's flying eagle, also used by American Overseas, has changed since its origin in '32.

Pennsylvania Central's "flying bullet" has undergone a series of changes to reach this form.

The pilot's wings of Northwest, designed in the late '20s, became the first air-mail symbol.

Delta's triangle, flanked with wings,, represents Greek letter from which line derives name.

Western's emblem was inspired by an Indian-head penny, back in '26. Here it is as of today.

The "Little Pilgrim" of Northeast symbolizes the territory that this air line serves.

For the last 11 years, Eastern has used a stylized peregrine falcon, symbol of fast flight.

With few changes, a blue world on wings has covered Pan American's global routes for years.

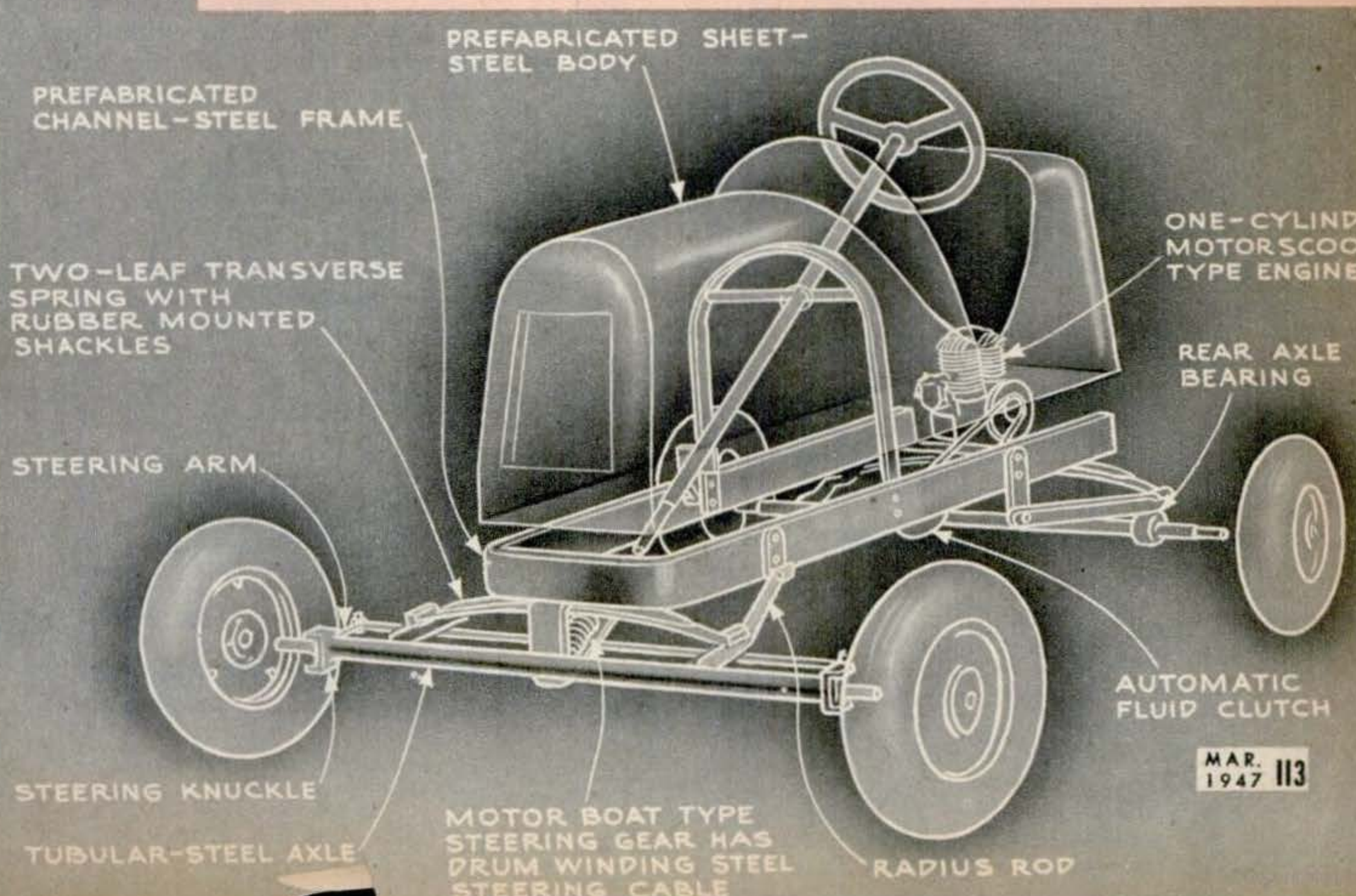
The present Braniff insignia depicts the Western Hemisphere as its field of service.

Transcontinental and Western, also known as Trans World, still keeps its initials and arrow.

The National ship's flag marks the "Buccaneer Route" designation of its Caribbean service.

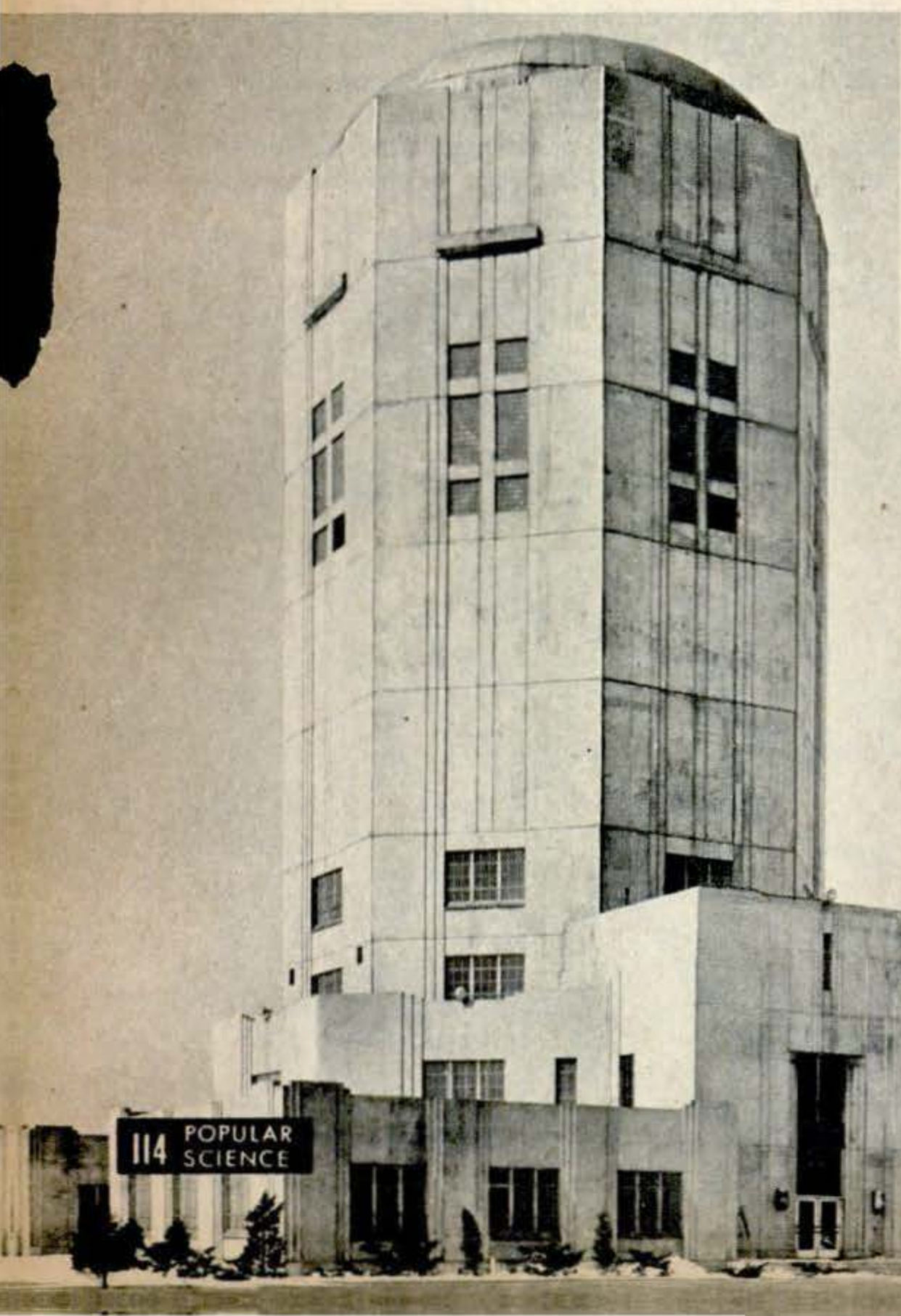
Midget Made for Highways

No, it isn't a midget racing car. It's a highway runabout that weighs only 300 pounds complete. Made by the Midget Motor Supply, of Athens, Ohio, it is called the King Midget. With a standard, one-cylinder, motor-scooter type of motor, it can hit about 40 miles an hour. Gas consumption? From 65 to 80 miles to the gallon, depending upon the road. The diagram below bares the chassis and shows the location of the motor car's various parts. Since the motor is in the rear, the driver's feet extend under the hood, which also has space for packages. The chassis, which comes knocked down, is bolted together. The midget has an automatic fluid clutch and semi-self-energizing brakes.

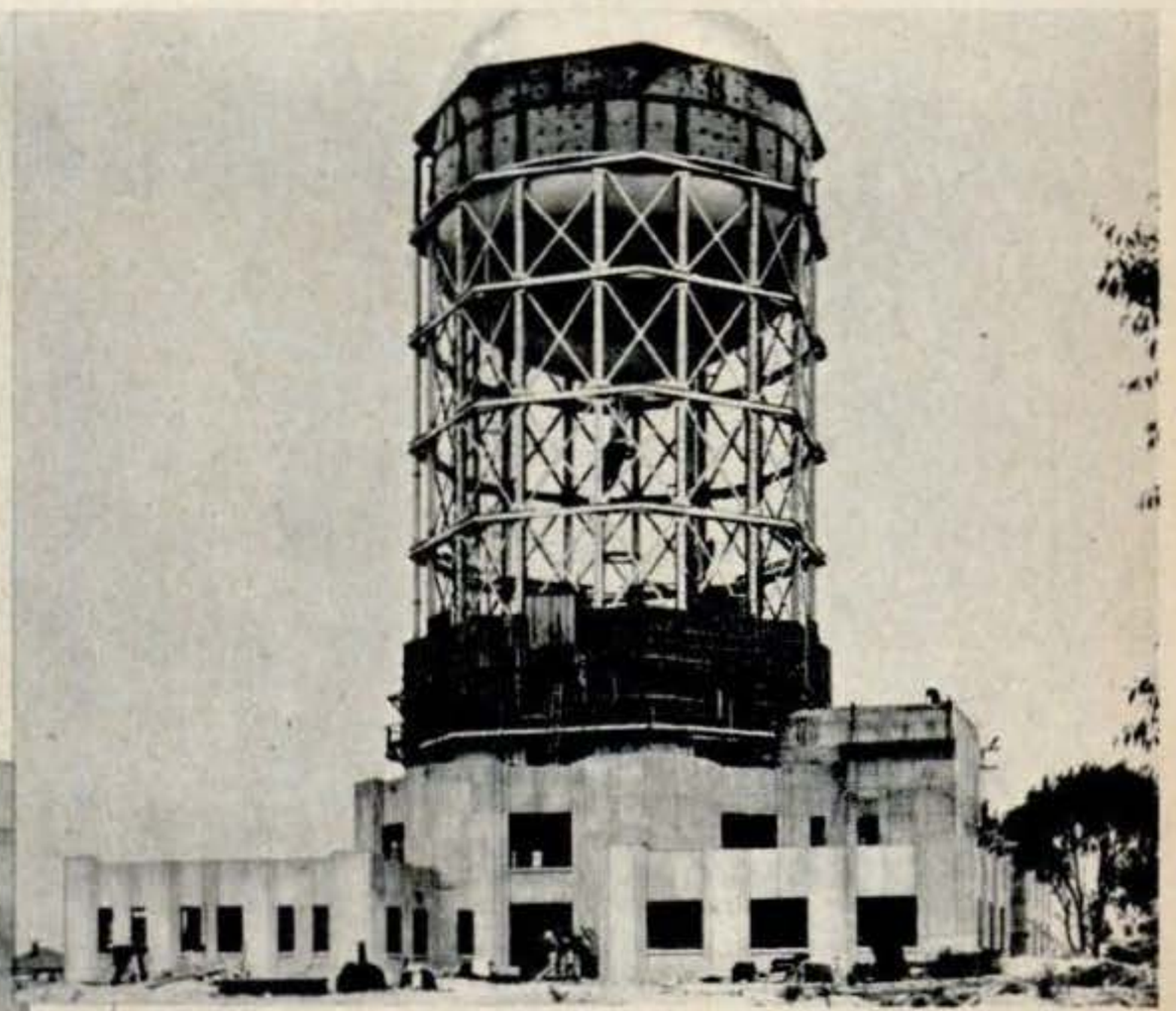


Pony Tractor Works Like a Horse. Although compact enough for garden and small farm use, this new heavy-duty tractor is a glutton for work. Its 4.1-hp. motor can haul a trailer at 10 m.p.h., as above, or pull a plow through heavy soil. Tires are water-filled to increase traction. The motor of the 635-pound machine can also be used to run belt-driven equipment. The automatic clutch is throttle controlled. The tractor is made by the Nichols Tractor and Equipment Co., Inc., of El Cajon, Calif.

Above, the tractor is hitched to a nine-inch mold plow, which may be set to desired depth.



Water Tank Turns Into Building. Below is the steel water tank that used to tower above the town of Lake, Wis. The girders around it represent a bright idea of the local citizens. Water tanks aren't very ornamental—so they enclosed it in concrete. The result is shown at left—a municipal office building whose tower hides the tank.



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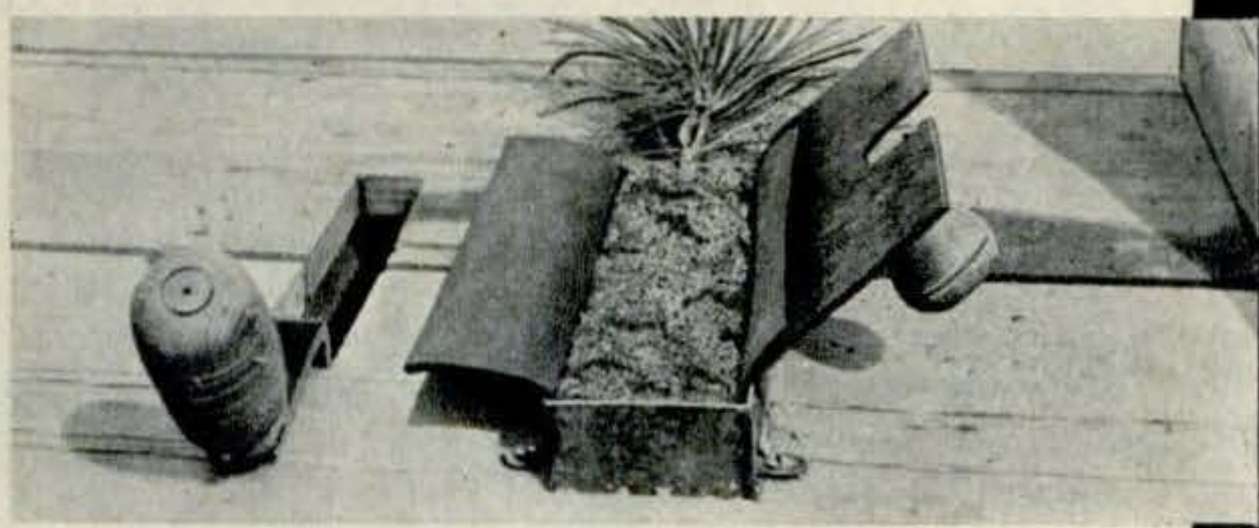
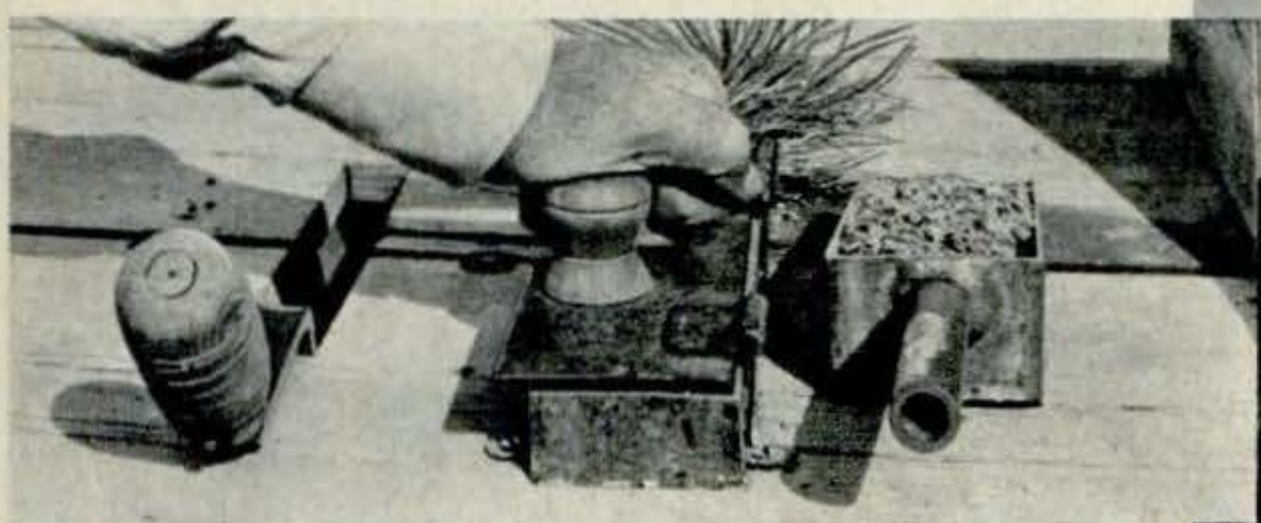
Paper Pots Make Trees Cheaper

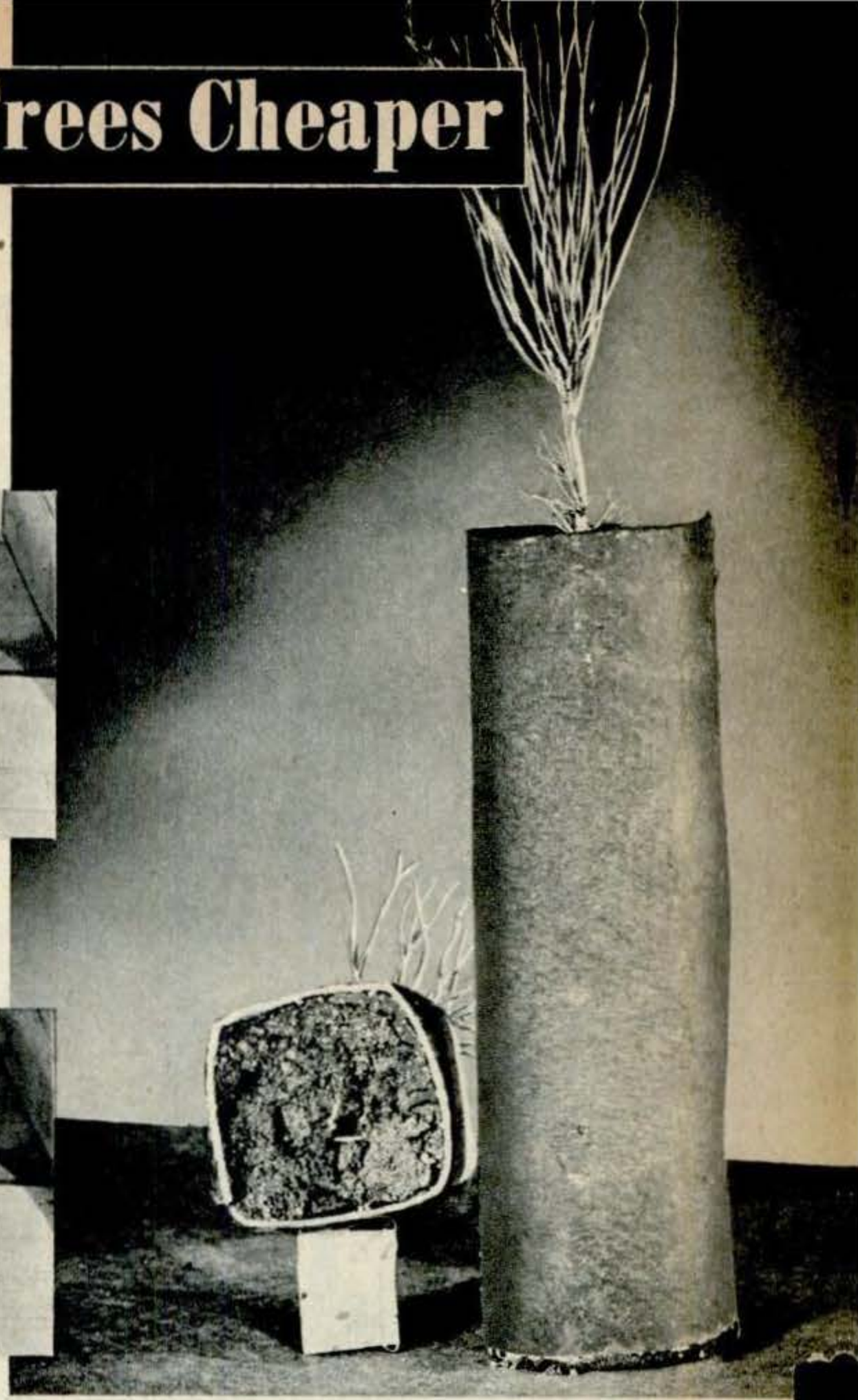
COST of raising seedling trees has been cut to less than 14 percent of normal with a new potting method developed by the Soil Conservation Service. Year-old seedlings, three to six inches high, are grown to a foot to 18 inches in a year at a cost of about five cents per tree.



Above, metal form is lined with tar paper and half filled with tamped clay loam. Seedling is then laid in and roots are covered with more dirt.

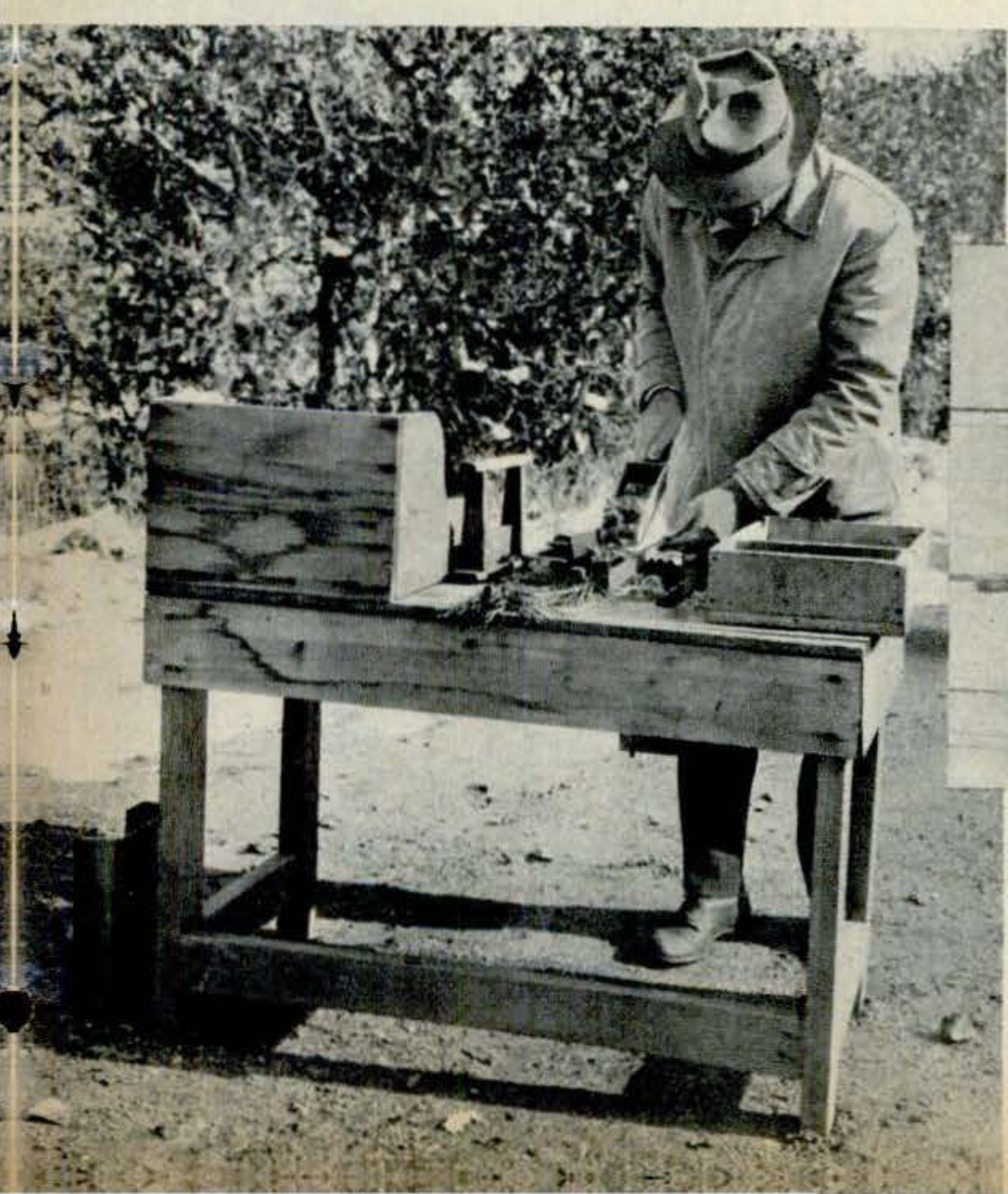


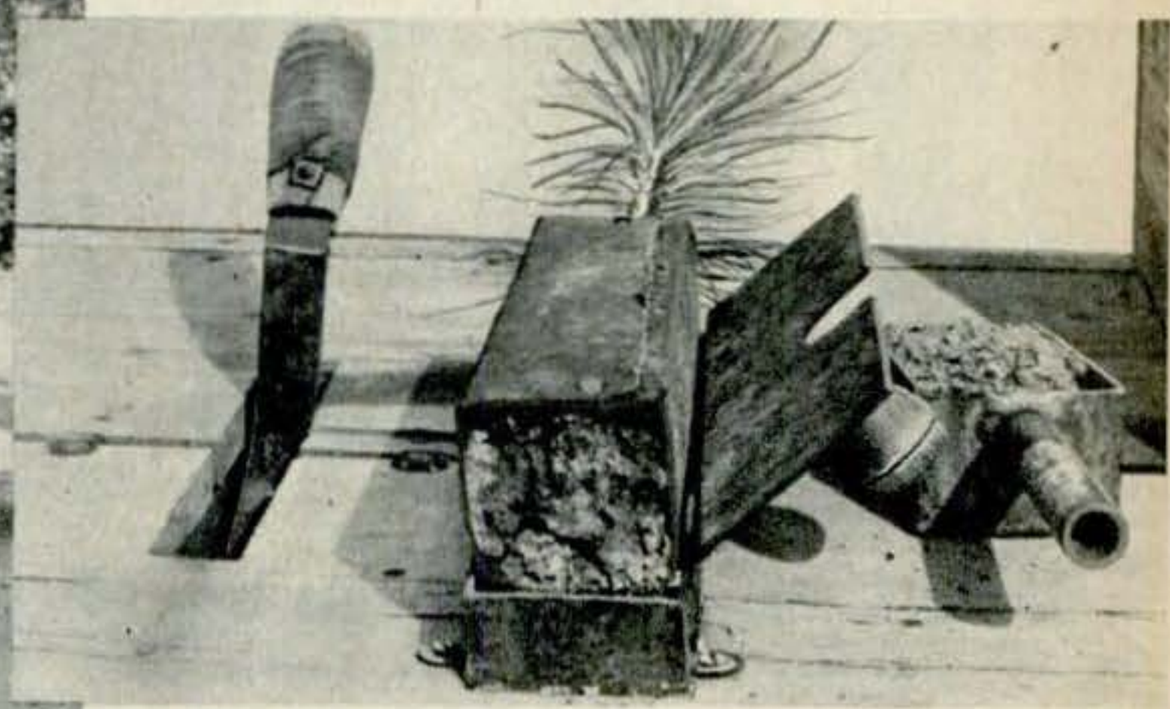
Tar paper is lapped over; cover is closed and held down. When lever at left is pushed forward, it will force up bottom of form to compress dirt.



Above, a potted seedling. For next year, it will be set upright with others, as close together as possible. Dirt is banked on outside of entire group.

At left, covering a ponderosa pine seedling in form set into workbench. Also suited to blue spruce, cedar and Douglas fir, method aids transplanting.





After dirt is compressed, cover is opened and tar paper fastened with nails. Then lever is pushed forward (as above), and bottom plate ejects seedling. As seedlings grow, roots penetrate wrappings.

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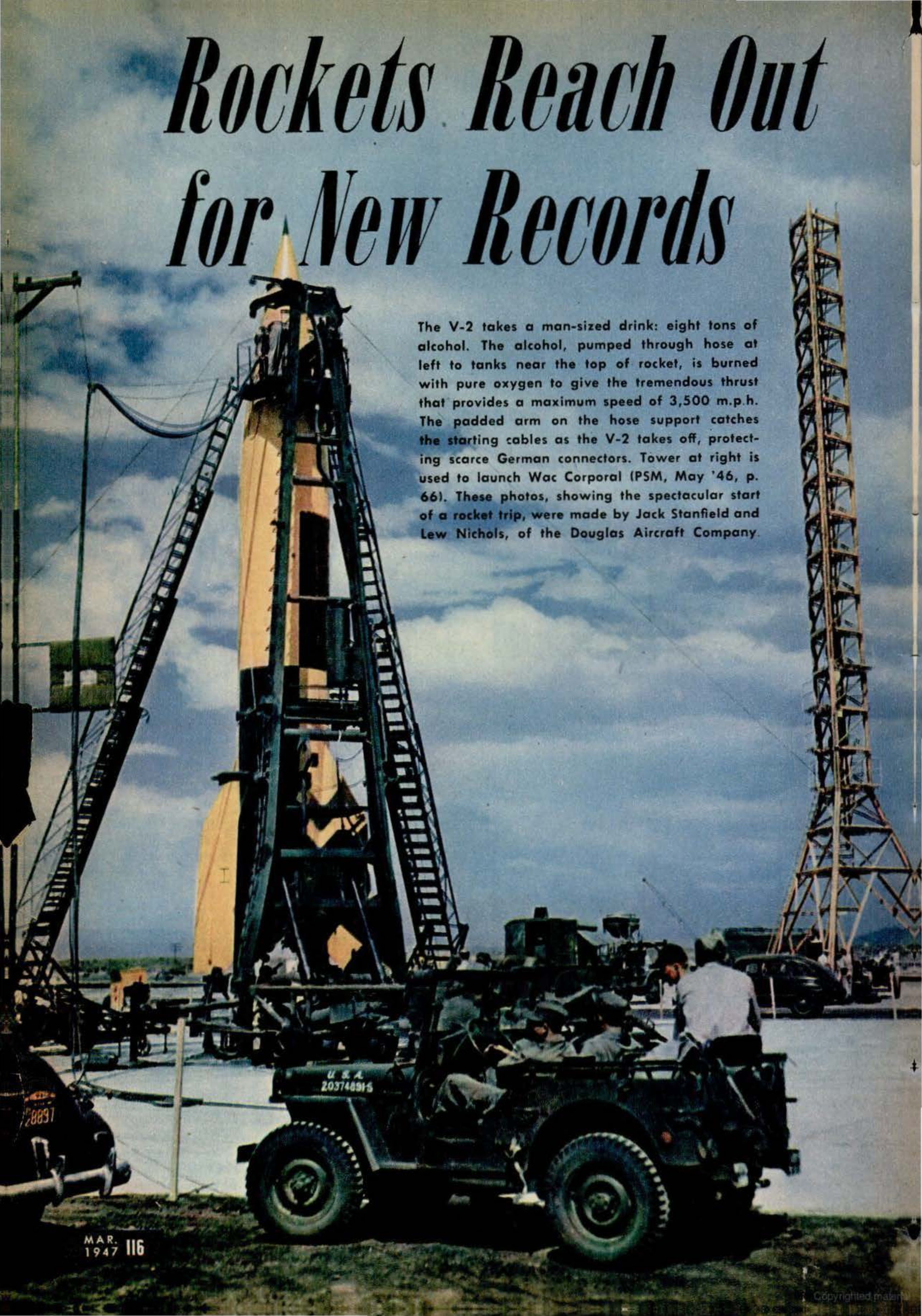
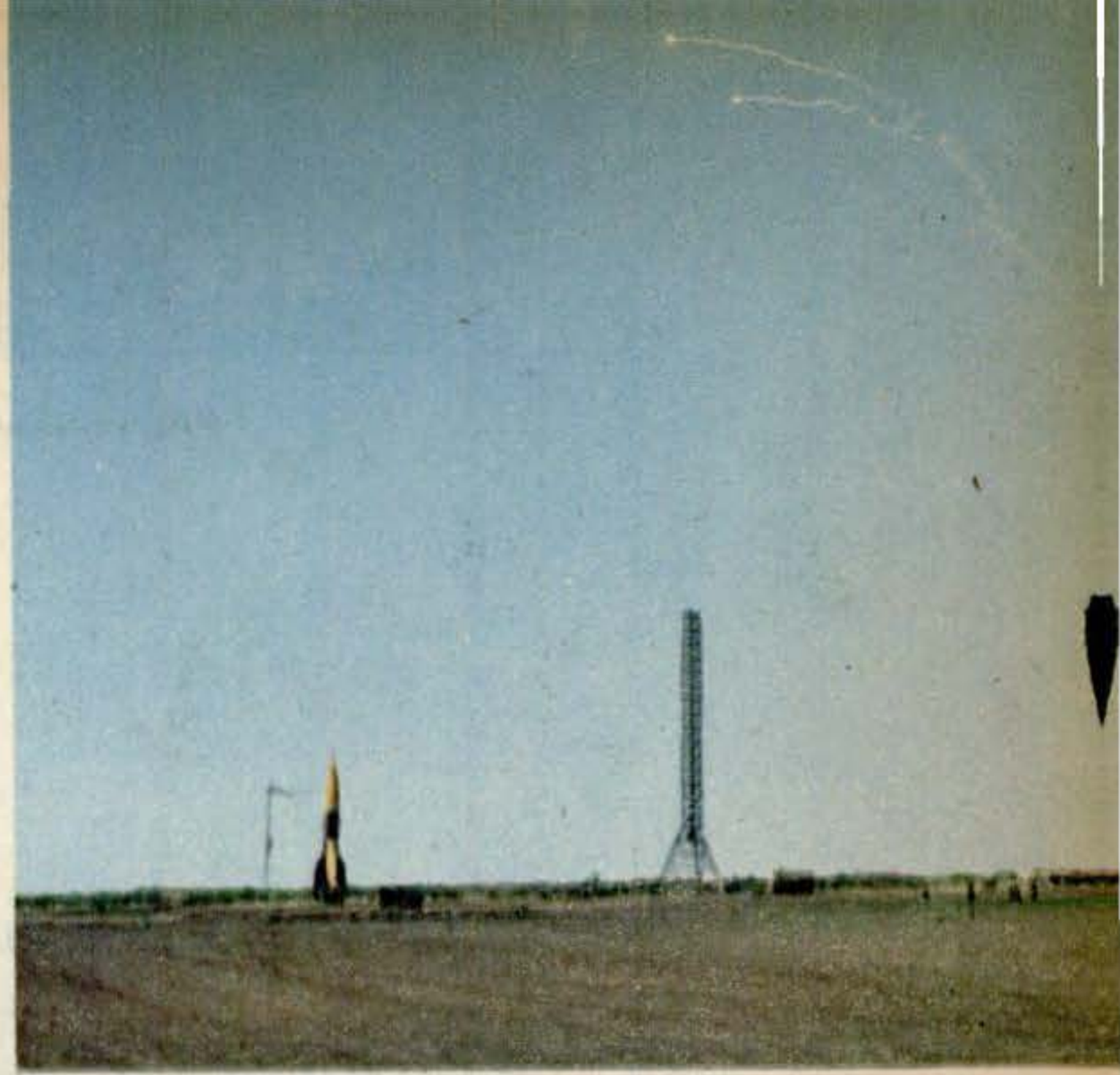
Rockets Reach Out for New Records



The V-2 takes a man-sized drink: eight tons of alcohol. The alcohol, pumped through hose at left to tanks near the top of rocket, is burned with pure oxygen to give the tremendous thrust that provides a maximum speed of 3,500 m.p.h. The padded arm on the hose support catches the starting cables as the V-2 takes off, protecting scarce German connectors. Tower at right is used to launch Wac Corporal (PSM, May '46, p. 66). These photos, showing the spectacular start of a rocket trip, were made by Jack Stanfield and Lew Nichols, of the Douglas Aircraft Company.

Copyrighted material

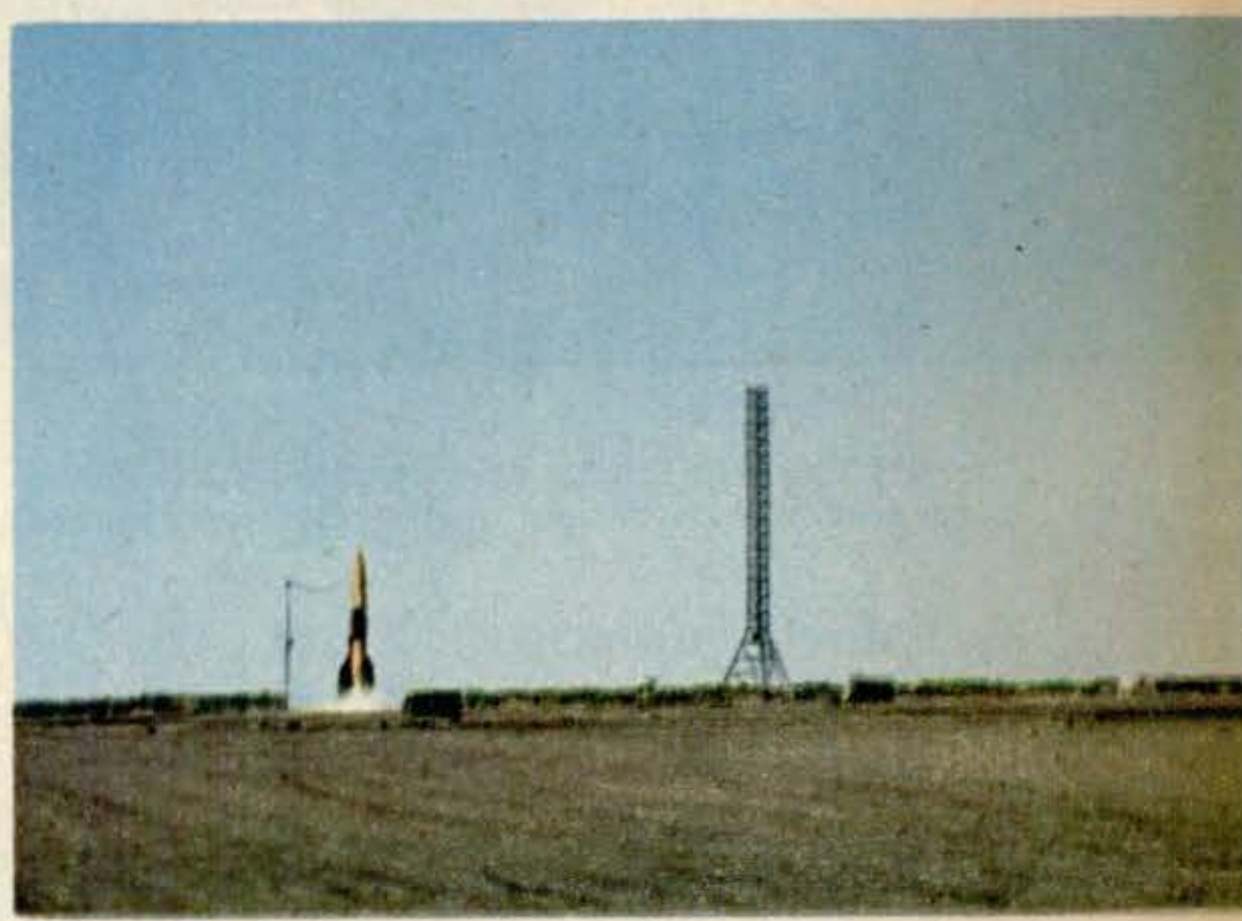
Frost outlines the oxygen supply hose; liquid oxygen is so cold (—297° F.) it condenses moisture even from dry desert air at White Sands, N. M.



The V-2 is ready now. Fuel tanks are full, instruments, controls and connections checked. The twin flares warn that there are only 60 seconds to go.

ONE BY one, secrets long hidden in the topmost fringes of the atmosphere—and outer space, too—are being ferreted out by high-flying rockets. Already much information on cosmic rays, radio-reflecting layers and other upper-air puzzles has been brought back to earth by instruments carried by German V-2s and American-made Wac Corporals. So fruitful have the rocket trips been that the Army Air Forces recently announced extension of the firing program to May of next year. A total of 50 V-2s, which can go about twice as high as the Wac Corporals, will have been sent aloft by that date.

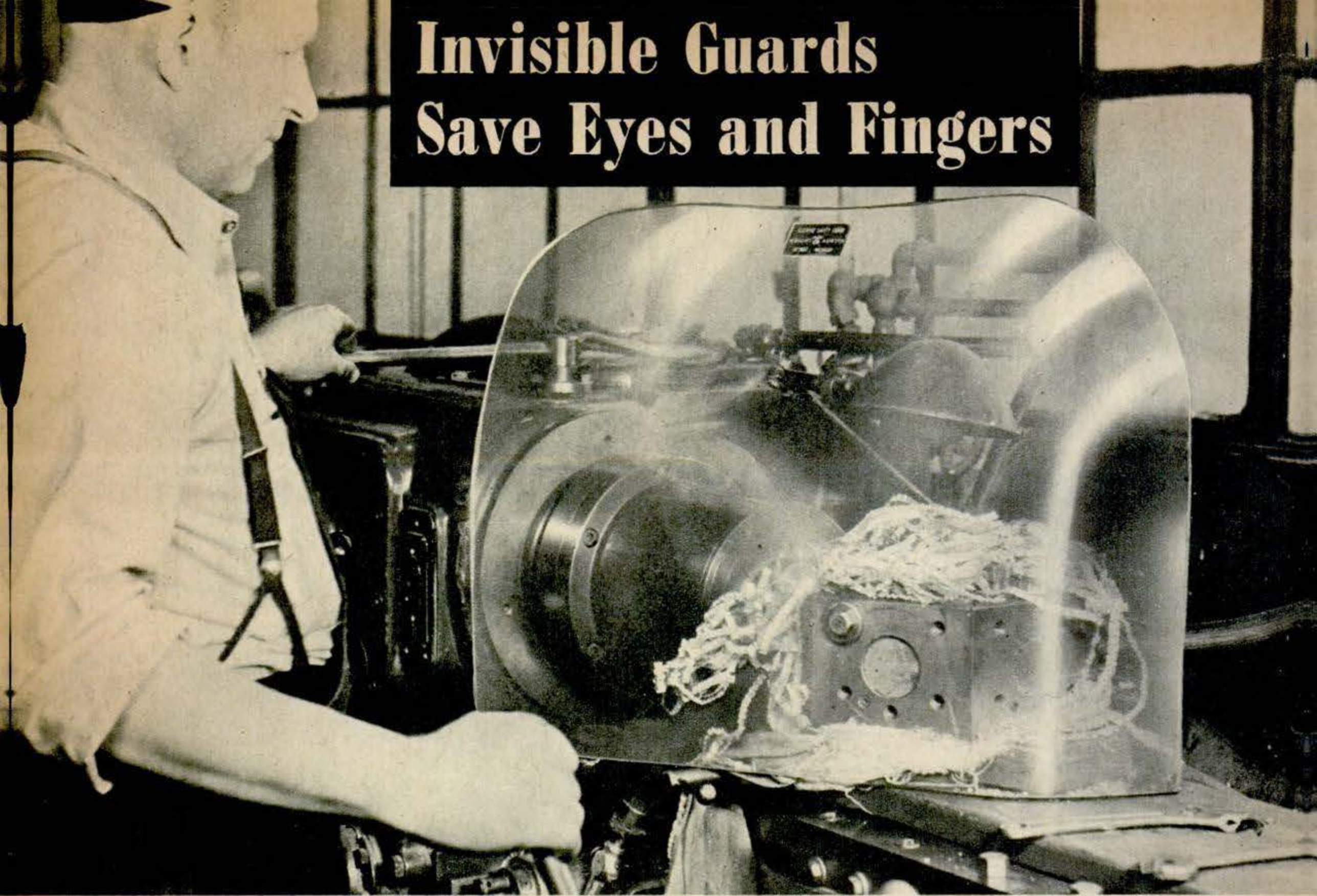
To provide that many complete missiles, numerous parts that were either missing or damaged in captured equipment will be manufactured in this country by the General Electric Company. Technical assistance in this task, as well as in other rocket research work, is being furnished by a large group of German scientists headed by Dr. Werner von Braun, inventor of the V-2.



A mushroom of flaming gas sends the rocket off on its long trip up as the operator in a blockhouse 350 feet away pushes the starting button.

The V-2 rises slowly at first, reaching 3,500 m.p.h. only near peak of its flight. Acceleration at the start is less than five times that caused by gravity.

Invisible Guards Save Eyes and Fingers



Photos from Rohm & Haas

Flying chips won't hurt an operator whose turner is covered with a Wright Austin Company guard.

By JOHN P. ARNOLD

IT'S SAFER if it can be seen. This is a premise on which all safety engineers are in agreement. And in their search for methods and materials with which to prevent industrial accidents, the engineers have found an admirable ally in the transparent acrylic plastics.

On the subject of protecting the workman from the machine, the experts put it this way:

Unguarded machines are not only dangerous in themselves, but they breed accidents because they make operators jittery and, therefore, more liable to blunder.

A guard that does not allow a full view of a process may irritate an operator to a point where he will discard it.

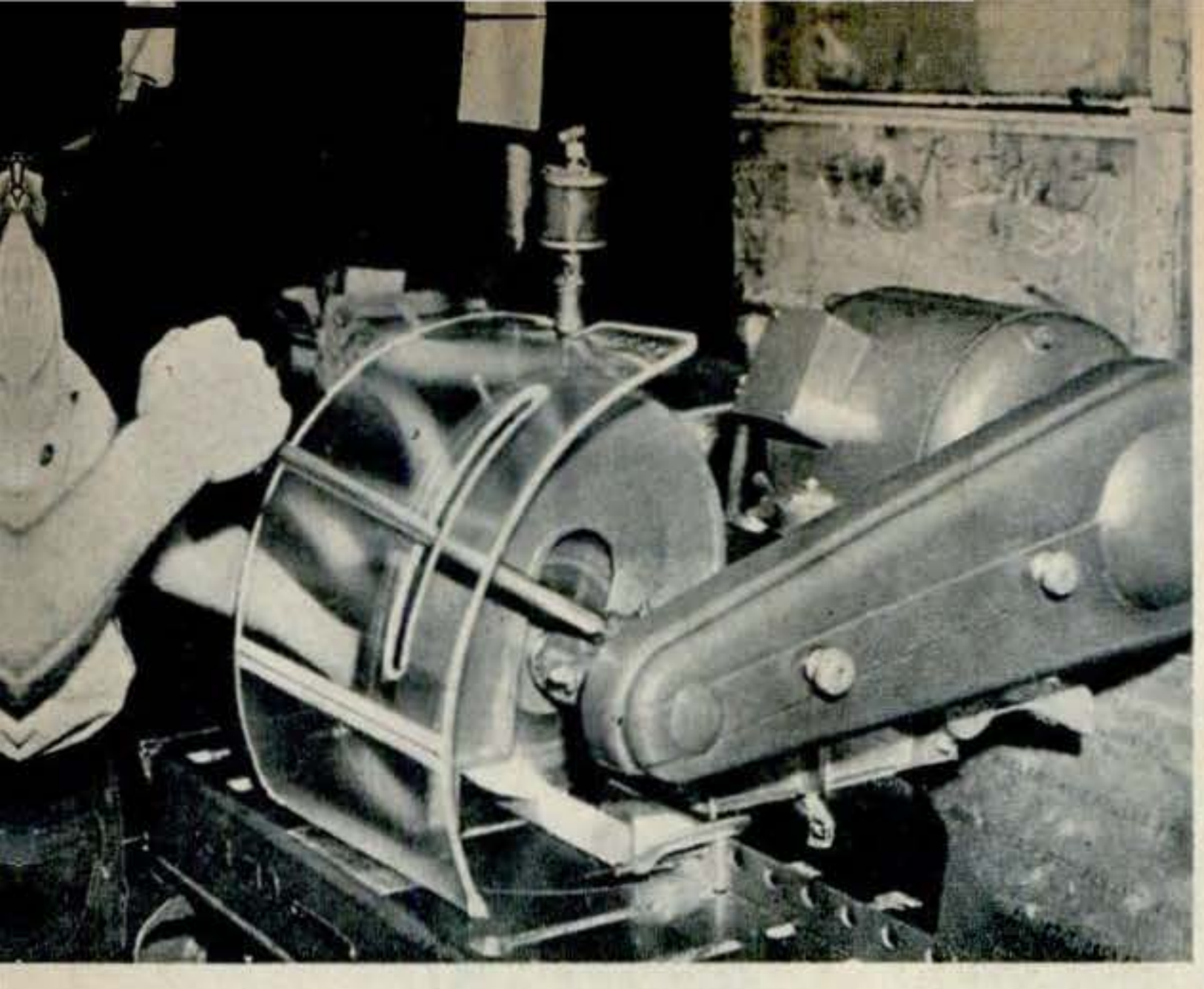
Guards lacking full visibility can be responsible for injuries by hiding signs of impending breakdowns.

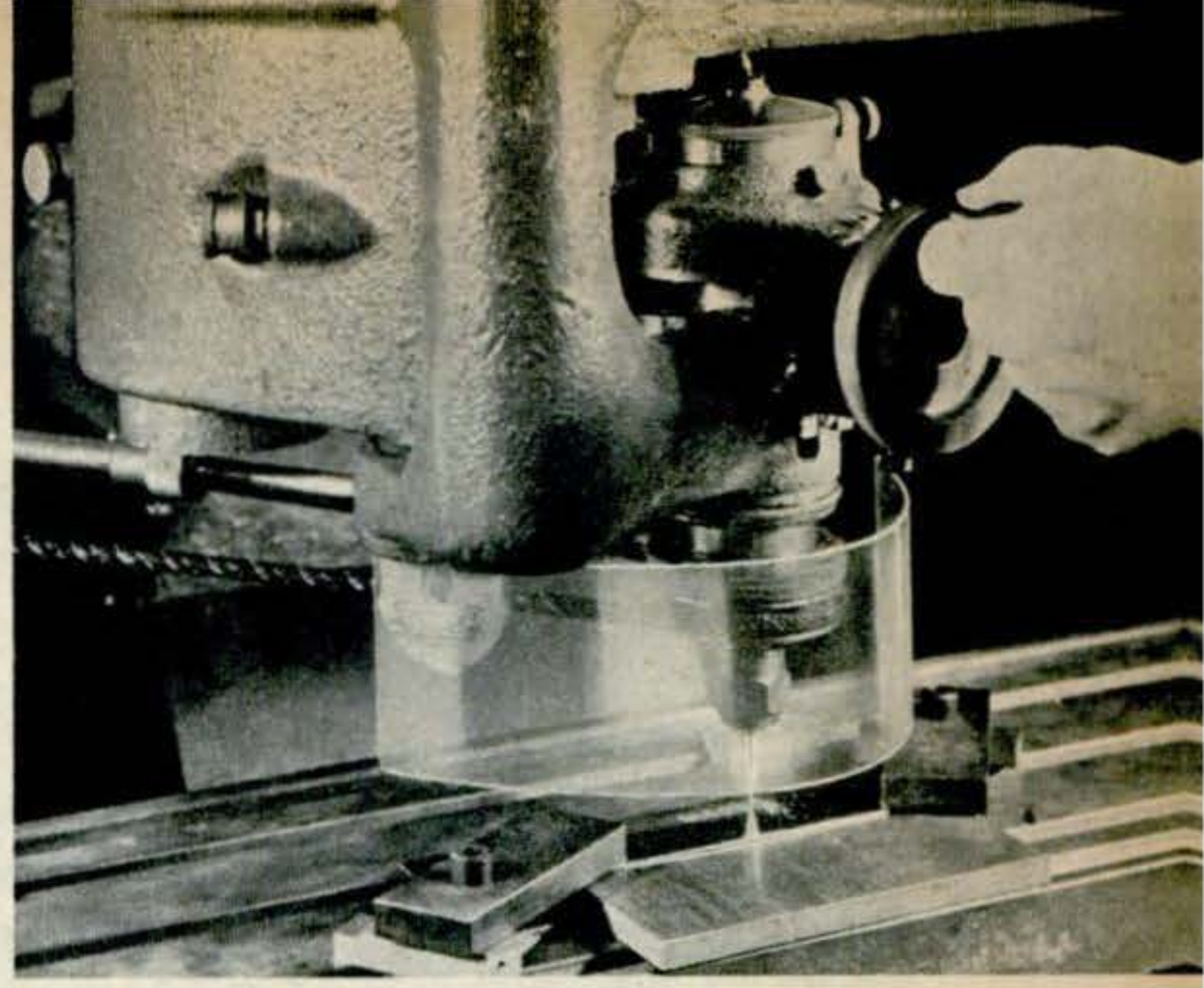
All this points to plastics—for the acrylics' first attribute is transparency. Yet, surprisingly, the plastics can resist the pitting of welding sparks and the abrasive action of grinding dusts even better than ordinary glass. They have an impact strength great enough to withstand normal shocks without breaking, and they are shatterproof, which eliminates the threat of flying splinters if they break. The materials are tough enough to be used on the ponderous machines of heavy industry as well as on the tools of general manufacture and the smaller workshops.

Being readily shaped, a plastic shield can be improvised on the spot for almost any mechanical setup. And plastics clean easily with soap and water. Another advantage lies in their excellent thermal and electrical insulating properties. Then, too, colored plastics can be used to reduce glare and relieve eyestrain.

The lightness of the acrylics allows them to be fashioned, for example, into basket guards for circular saws, where metal protectors are often an inconvenience. And some commercial types of plastic shields come fitted with magnets for attachment to various machine parts.

So far, the full possibilities of the plastics as protection agents have by no means been fully explored. It is certain, however, that the material, once valued largely for its decorative qualities, will play an increasingly greater part in lowering the injury rate in the industrial world.

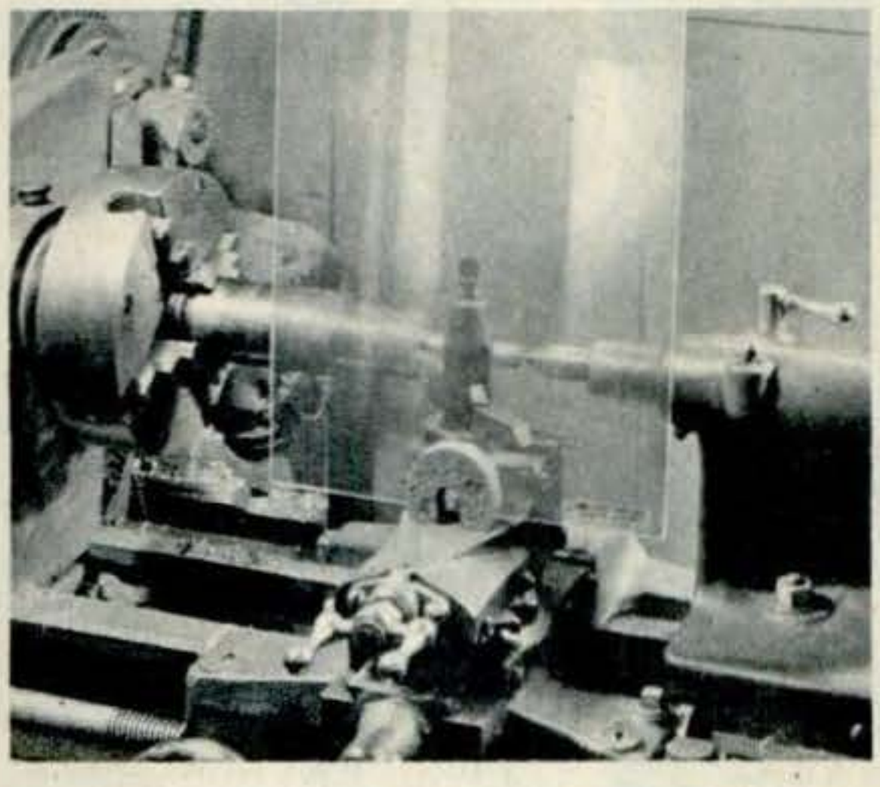




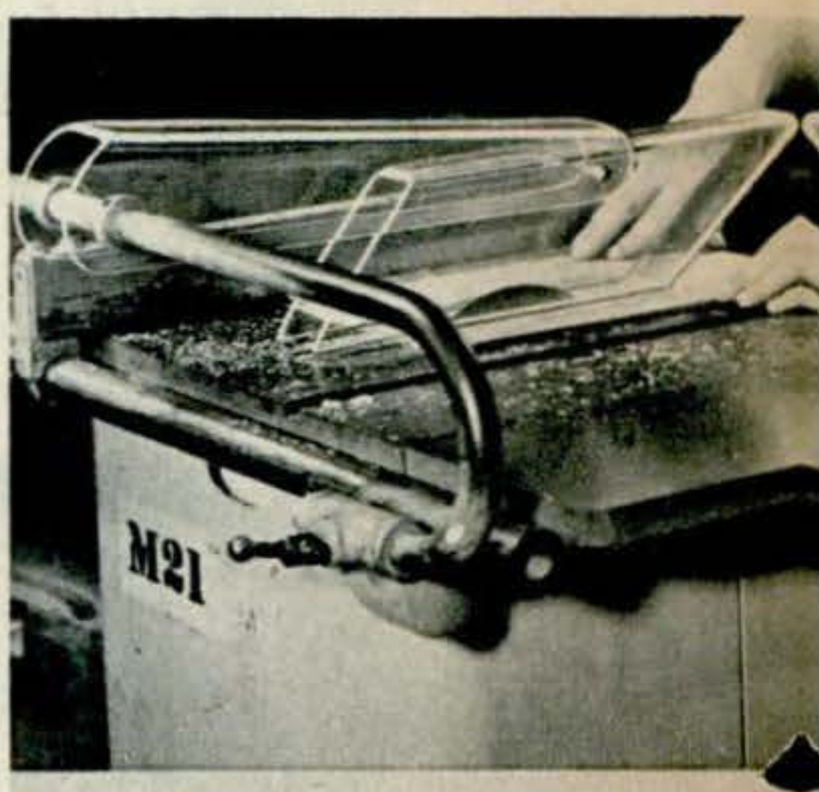
Workmen don't like to wear goggles—and don't need to with the tough plastic shield (above) designed by Republic Aviation for its shop saws.

Because of its simplicity, this shield, designed by Dilley Manufacturing Company, can be fitted to a variety of machines without great modification.

Dental labs use this Dilley Plexiglas guard. It helps recover gold filings and protects worker as well.



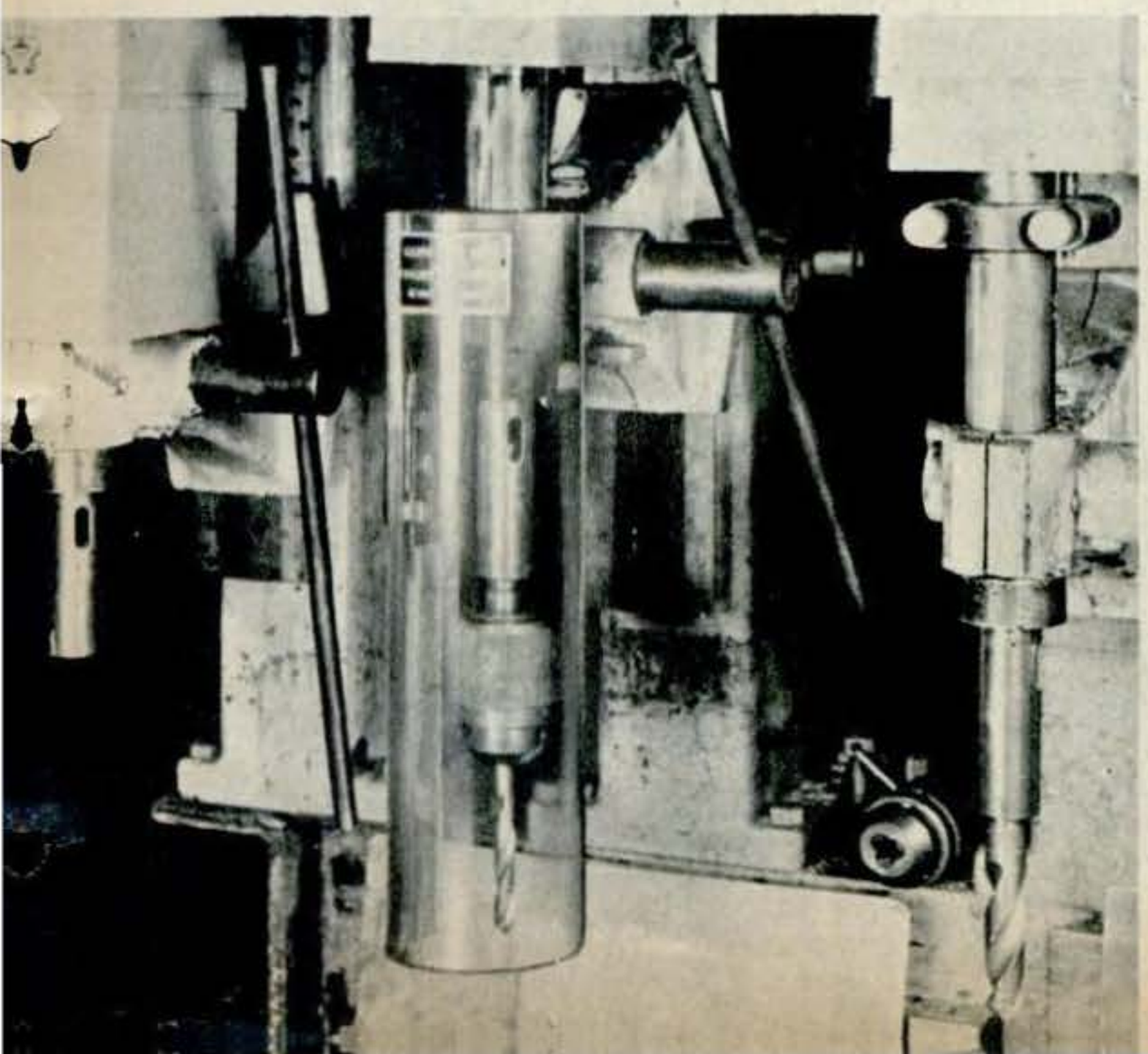
Just an upright pane of plastic is enough to guard machinists operating this abrasive machine. It is a Dilley product.



Here is another adaptation of plastic guards to saws, offering maximum protection and complete visibility.

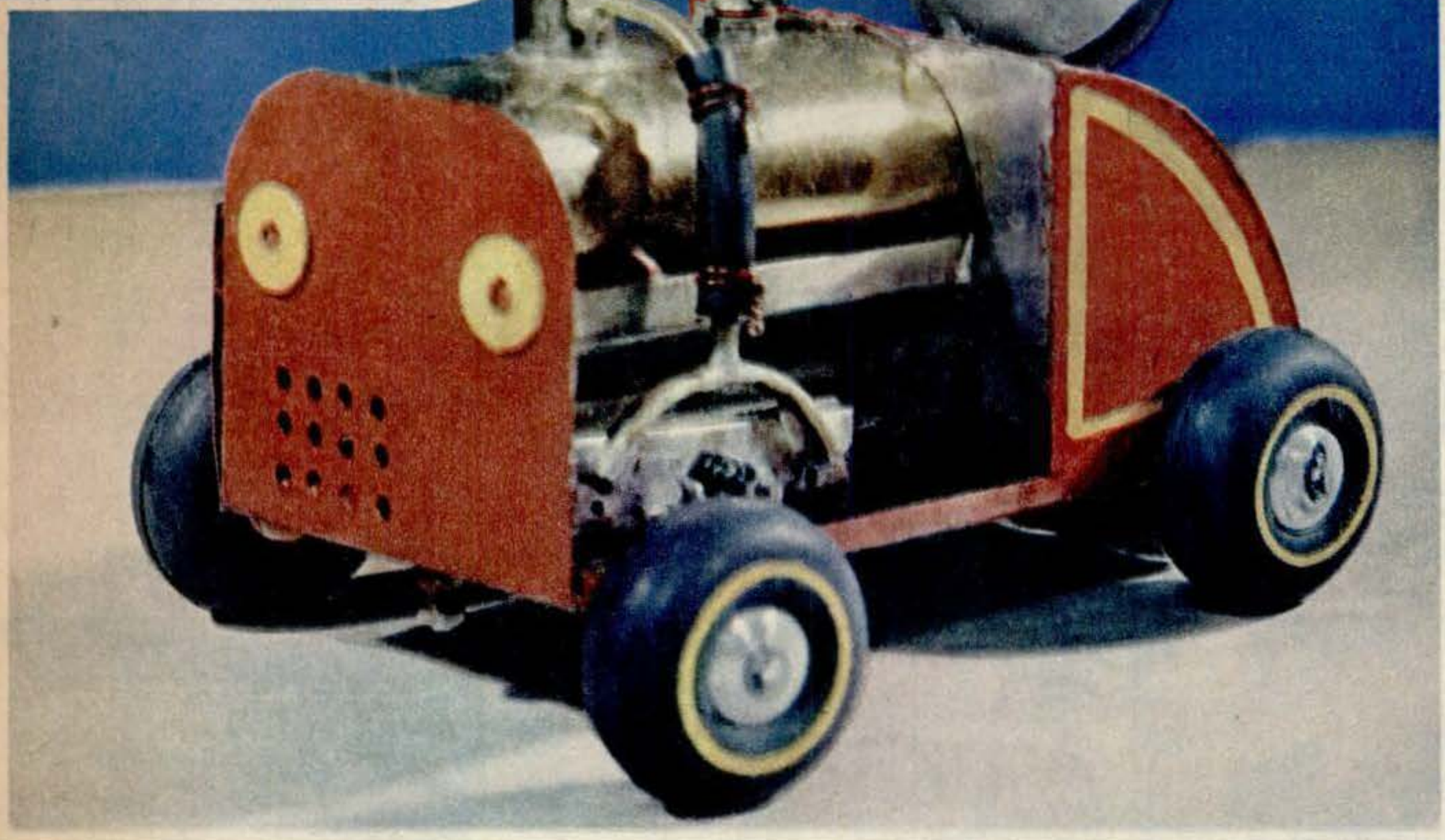
Whirling drill and chuck (below) are completely encased in a Plexiglas guard, also manufactured by Wright Austin. All of covered machine is visible.

Note the thickness of the plastic shield protecting workman (below) from physical injury. It can be fitted to many types of drills, stampers, presses.



CRAFTWORK

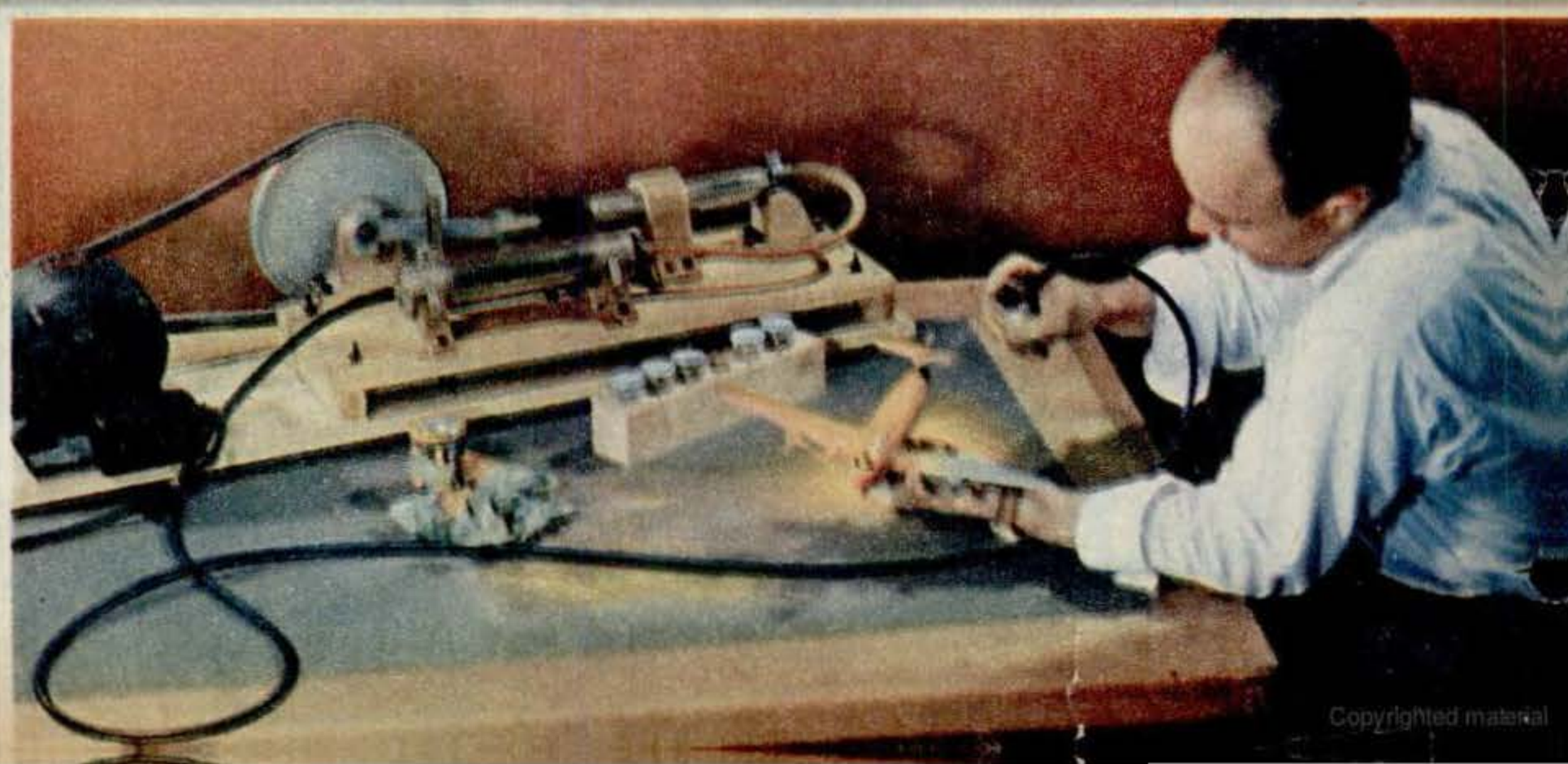
PROJECTS OF THE MONTH



MIDGET CAR RUNS BY STEAM. This little 5" racer is powered by a double-acting oscillating engine and an alcohol-fired boiler. Its front wheels can be adjusted for a circular course, and model-airplane tires keep it from skidding. The engine, steam manifold, and boiler are made of brass; the chassis and other parts are tin-can stock. Turn to page 162 for construction details, drawings, and other photographs.

BUNNY CRADLE. A project for a father with a young baby, this nursery piece has a dual purpose. The cradle part can be lifted off for use as a basket-bed on an auto trip. See page 150 for how-to-make information and plans.

SPRAYING WORKSHOP PROJECTS. No better finish can be put on prized craftwork pieces than a smooth one of sprayed enamel or lacquer. Shown below is a compressor and sprayer outfit for small and medium-sized projects. It can be built right in the home workshop where it will be used. Plans and instructions for making it are given on page 174.



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The track of cosmic-ray particles, marked by droplets of vapor condensed on gas ions, is recorded by the stereoscopic camera held at right by J. E. Laurence, of the Office of Naval Records. The camera works automatically when a particle enters the cloud chamber and trips a Geiger counter.

Why B-29s Hunt COSMIC RAYS

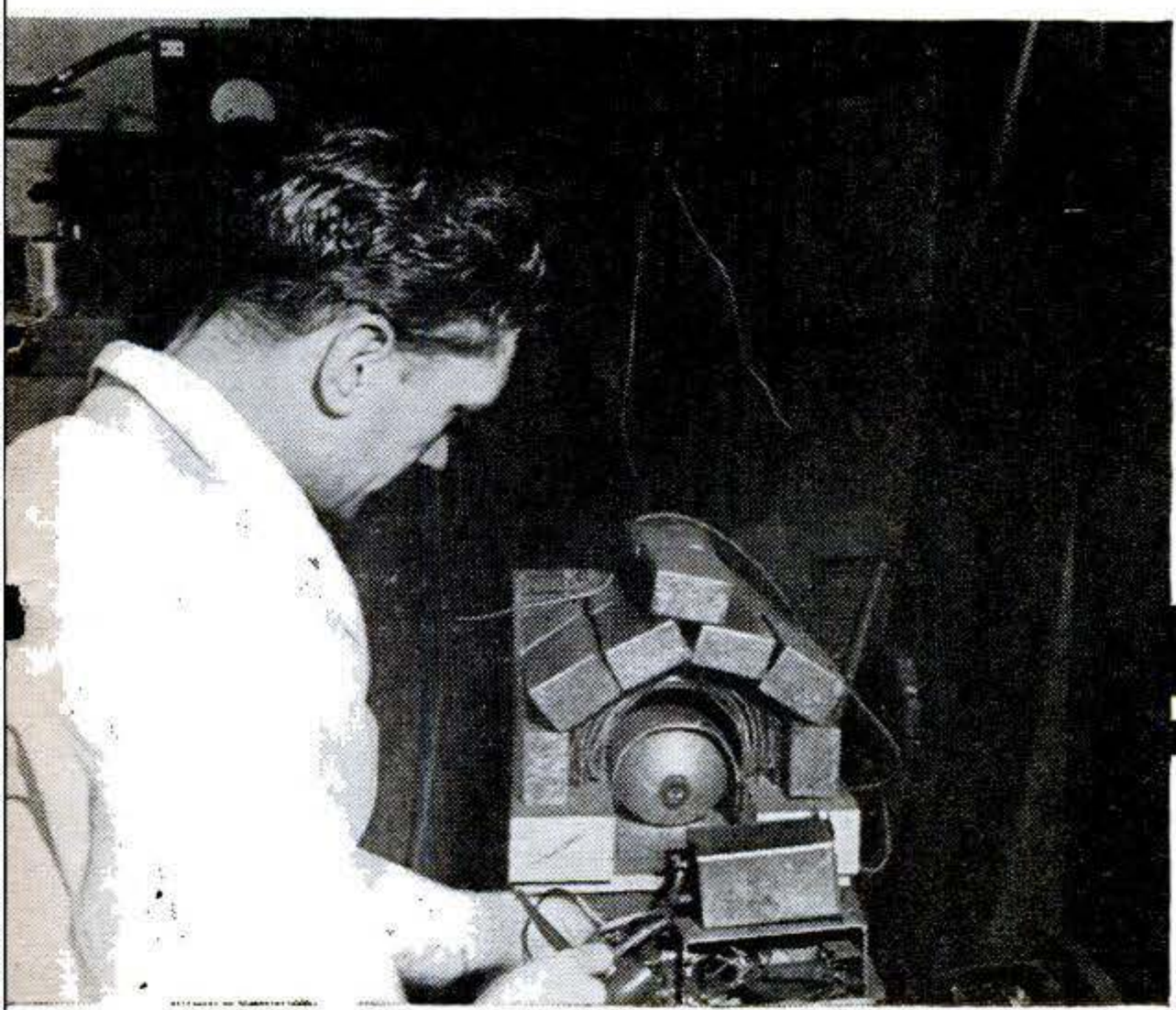
THE mighty B-29 has a new job—being bombarded instead of dropping bombs. But this time the bombs are not man-made. The big plane is carrying apparatus aloft to photograph the arrival of mysterious cosmic rays from outer space. The rays smash into the plane eight miles above the ground—and a camera catches them in the act.

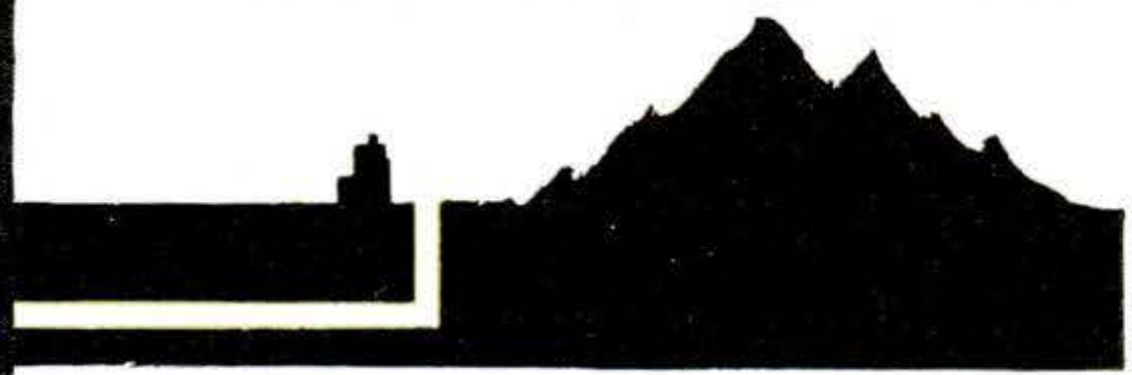
Three of the great bombers are going up nearly every day from the Naval Ordnance Station at Inyokern, Calif. Dr. Carl D. Anderson, famed California Institute of Technology physicist, and his opposite number at the University of California, Dr. Robert Brode, are directing the Navy-sponsored research. It is part of the global campaign waged by scientists to map the elusive rays.

At widely scattered points on the earth's surface, measuring devices have been buried deep in mine shafts, sunk in lakes, placed on high buildings, exposed on barren mountain tops, pulled up into the air by free balloons and shot into space by rockets. Thus we have learned that some cosmic rays can penetrate the equivalent of more than 400 feet of lead, that they are more intense in winter and in high latitudes, and that they are affected by the earth's magnetic field. Geiger counters in V-2 rockets have shown increasing ray intensity up to 70,000 feet, then a drop to a low point near the outer edge of the atmosphere.

By using the cloud chamber (PSM, Sept. '42, p. 44), scientists have also found that the rays are composed of several different kinds of particles.

Cloud chambers also have been carried to mountain tops, but these heavy, cumbersome, intricate devices have not been dispatched by rocket and balloon to the upper heavens for further research in that ray-rich





The study of cosmic rays is being carried on from high in the heavens to the depths of the earth. At left, Dr. E. P. George is shown at work in a tiny room 100 feet under London. He is adjusting an ionization chamber, studying the effect on lead blocks of cosmic rays that have penetrated to this depth.

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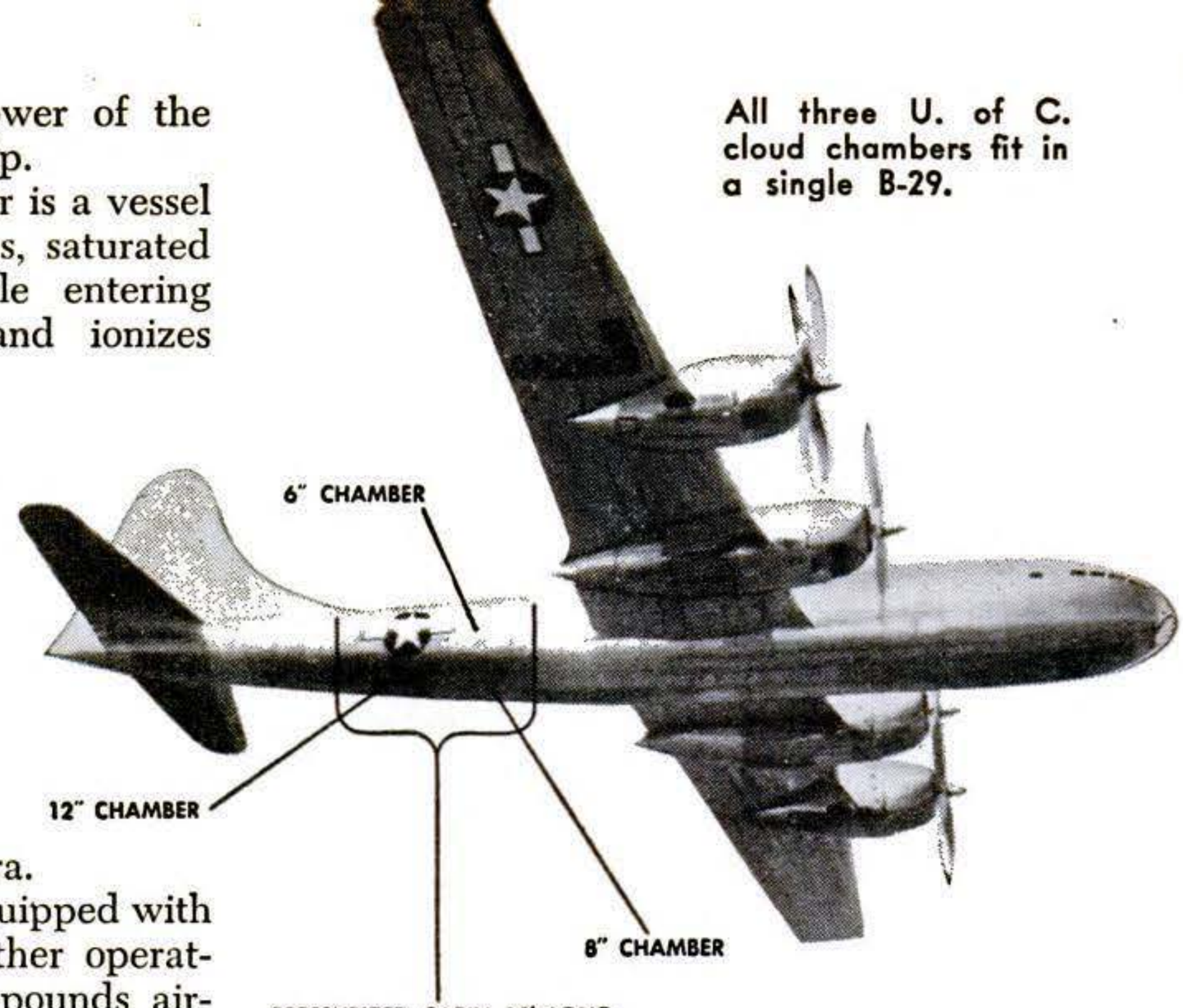
region. So the great lifting power of the B-29 has been called in to help.

Essentially, the cloud chamber is a vessel containing air or some other gas, saturated with vapor. A cosmic particle entering it collides with gas atoms and ionizes them. At the same time the chamber is expanded automatically, dropping the temperature as much as 25° so that the gas becomes supersaturated. Moisture condenses on the ions along the particle's trail and this visible track is photographed. A Geiger counter triggers the expansion and turns on lights and the camera.

Caltech's 6½-inch chamber, equipped with pumps, counters, motors and other operating mechanisms, weighs 5,000 pounds airborne. It is already a veteran, having caught more than 100,000 cosmic rays at sea level



All three U. of C. cloud chambers fit in a single B-29.

6" CLOUD CHAMBER IN RIGHT FORWARD CORNER
8" CLOUD CHAMBER IN LEFT FORWARD CORNER
12" CLOUD CHAMBER IN RIGHT REAR CORNER

Apparatus below is the California Institute of Technology's 6½-inch cloud chamber, set up as in a B-29.

COOLANT DISTRIBUTORS

SELENIUM RECTIFIERS

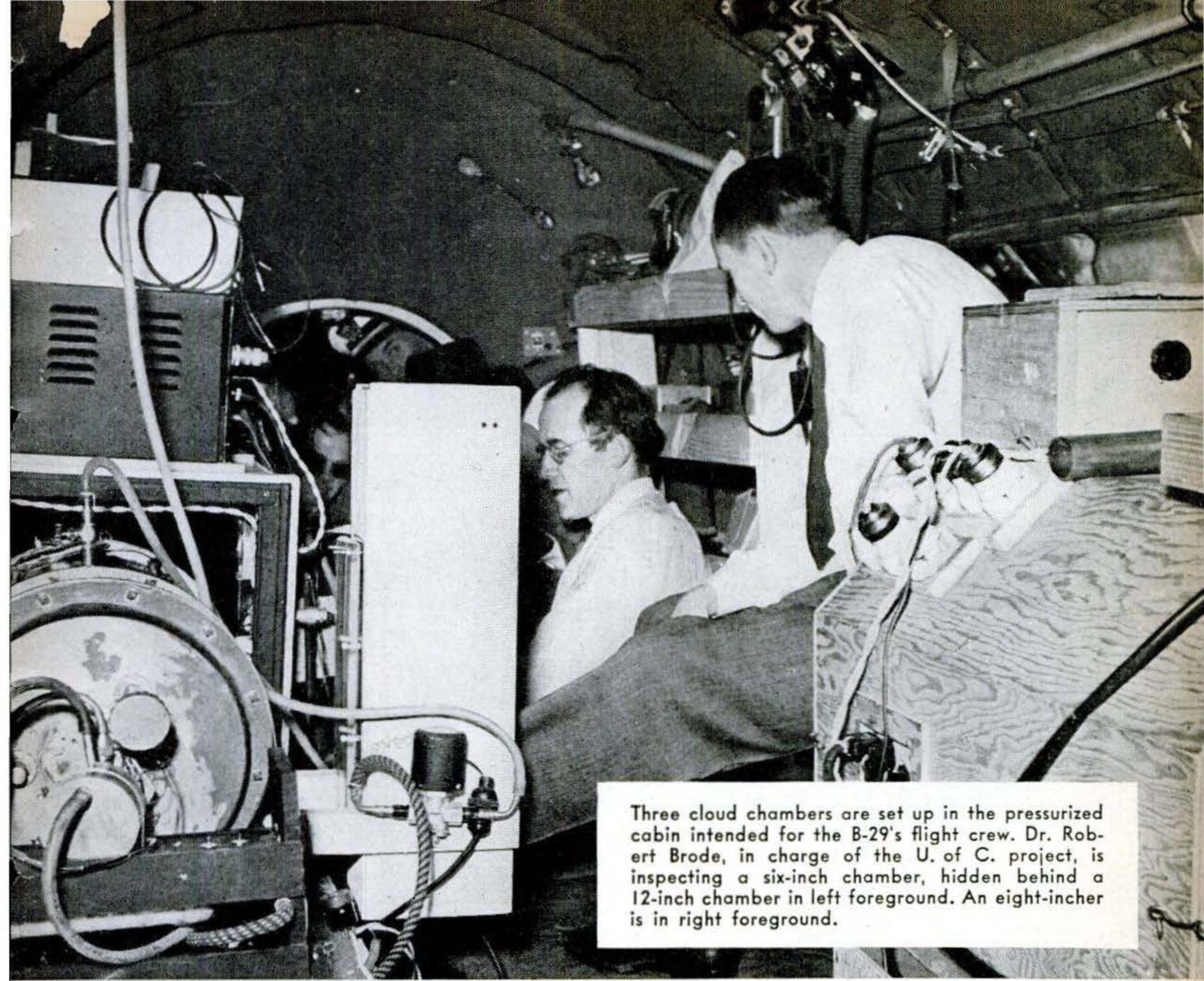
EXPANSION CONTROL UNIT

VACUUM TANK

SOLENOID CAUSES CHAMBER TO EXPAND WHEN RAY STRIKES

COMPRESSOR AND COOLANT-PUMP MOTOR

COMPRESSED-AIR TANK



Three cloud chambers are set up in the pressurized cabin intended for the B-29's flight crew. Dr. Robert Brode, in charge of the U. of C. project, is inspecting a six-inch chamber, hidden behind a 12-inch chamber in left foreground. An eight-incher is in right foreground.

and 10,000 of them at 14,000 feet on Pike's Peak. It takes about one picture a minute.

The University of California's equipment, all packed within a single B-29, includes three such cloud chambers: a small, six-inch, non-magnetic device fitted with horizontal copper and lead plates; a 12-incher; and an eight-inch chamber with a magnetic field.

This magnetic field pulls particles from a straight path and the resulting curve is a measure of their mass and speed. The metal plates of the six-incher give further information by revealing the penetrating power of the particle. Study of size of drops, curvature, production of secondary particles, and penetration are combined to deduce what particles are found.

In this way, much has been learned about the various types. The positron is a positive electron, a very light and unstable particle. Dr. Anderson's first photograph revealed it to have the mass of an ordinary electron. Neutrons, electrically neutral, and the familiar proton both have been observed in cosmic rays and play an important role in nuclear disintegration. Yet another variety is the photon, an electrically neutral electromagnetic radiation.

Problem child of the family is the mesotron, the particle most frequently found on the earth's surface. Mesotrons may be electrically positive, negative or neutral, and weigh 200 to 250 times as much as electrons. They come into being, flash through the atmosphere and disintegrate into other particles in about two-millionths of a second.

The mesotron, according to one theory, isn't a true cosmic particle at all, but a secondary particle produced by the collision of cosmic rays with the outer atmosphere. This would account for the falling off in

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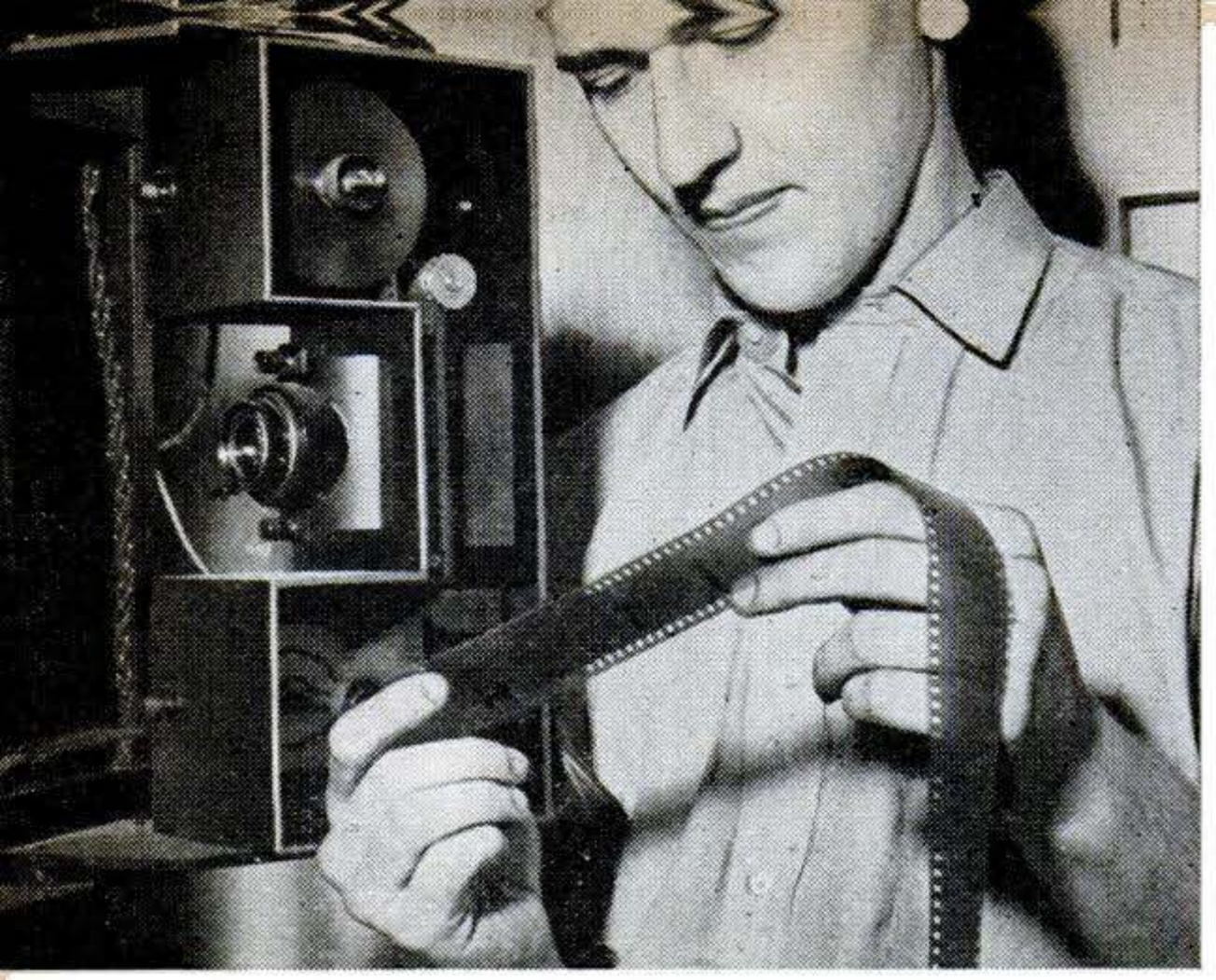

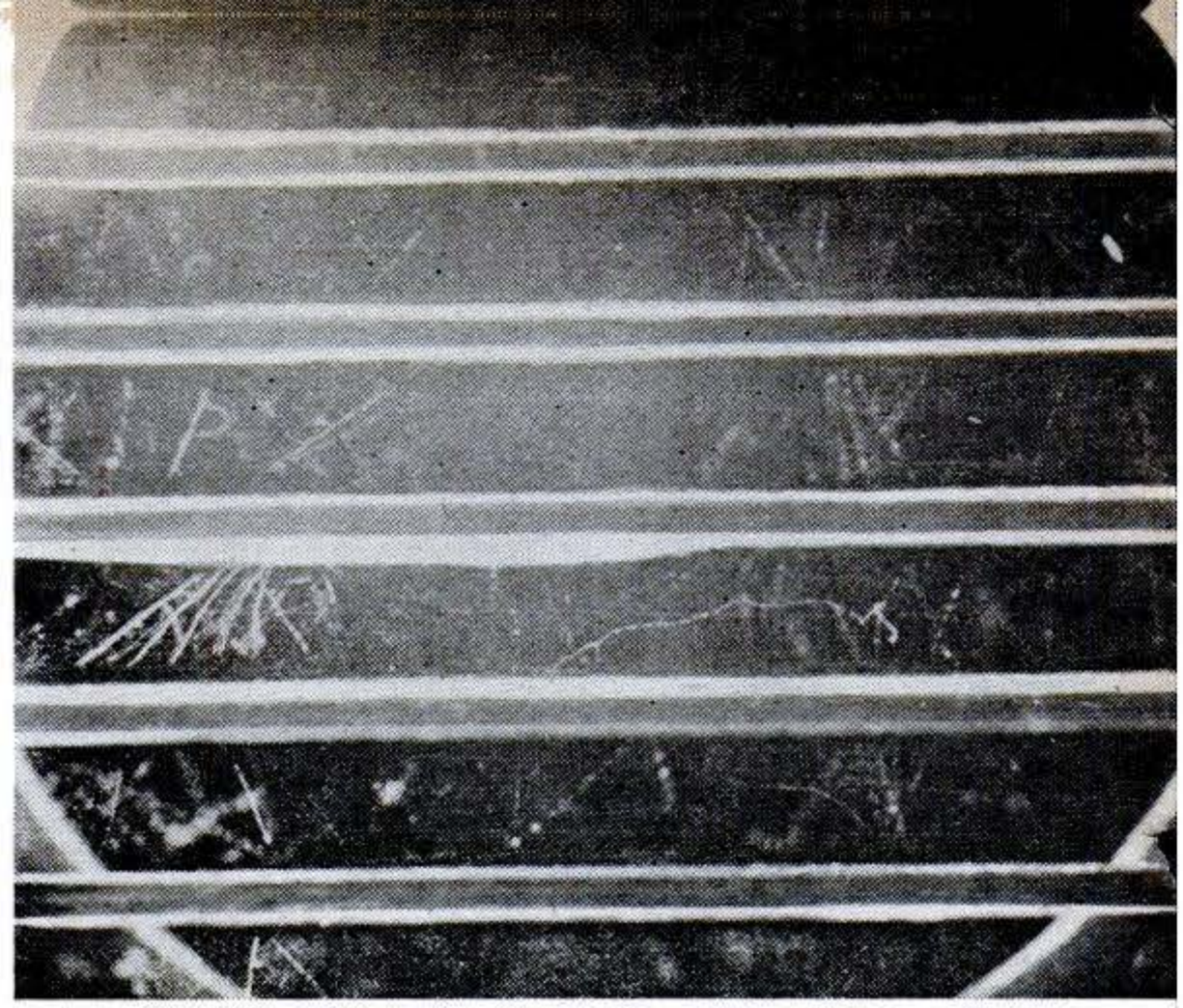

One in a thousand pictures made aloft may prove interesting. At right is cloud-chamber shot at 35,000 feet. Heavy bands are copper and lead plates. Lines of equal density above and below plates indicate protons. Mesotrons may stop at plates. Heavy particle shower at lower left is from a hit on lead plate.

the intensity of cosmic radiation in the uppermost levels, beyond the point where most mesotrons would be produced. This would also account for the effect of temperature on cosmic ray intensity: Warm air pushes up the outer limits of the atmosphere, the mesotrons are formed at a higher level, and fewer of them live to reach the ground.

"Mesotrons, found only in cosmic ray phenomena, are a component of the rays themselves, at least as the rays strike sea level," says Dr. Anderson. "Mesotrons play an extremely important role in the processes responsible for the exceedingly strong forces present in the nuclei of atoms of all kinds of matter. The mesotron promises to be the key to our understanding of these nuclear forces. This problem may be one of the most important in physics today."

Scientists are on the lookout for yet more particles, still undiscovered. Russian scientists, for example, have reported observing negative protons. So far, no one in this country has found any, but American scientists do not discount the Russian claims. They know that earlier forecasts, such as the Japanese scientist Yukowa's prediction that mesotrons exist, have proved true. Dr. Brode believes that if the new protons do turn up in the cloud chambers they will probably be extremely short-lived, like the proton and mesotron. Meanwhile, experts are talking about the chance that the proton may carry a double charge of electricity. "These," remarks Dr. Brode, "are the things we carry in the backs of our minds as we look through miles of film."

The known particles deliver energy greater than man has ever been able to create. "Particles of energies of several billion electron volts are among the most common," says Dr. Anderson, "and in extreme cases these may reach or exceed one thousand billion. At the present time there is no source of radiation comparable in quantum energy with cosmic rays—making them an important research tool."

Dr. Brode's energy estimates go even higher. "I would raise him three figures on that," he declares. "Particles of a million billion electron volts are found. One does not have to build an expensive generator to get high energy particles; we have them all the time in cosmic radiation."

What can be done to put these forces to work? Nobody knows. So far, no way has been found to focus cosmic particles in a beam to disintegrate atoms in the laboratory. A cyclotron will hurl billions of particles per square inch per second at an object. At sea level, about six cosmic ray particles strike the same area per second. The difference is comparable to that between a fire hose and a patter of rain.

But cosmic rays may do more than bring us energy from afar. Biologists have long puzzled over the way the genes, those hypothetical particles that control the body's characteristics, apparently change, producing biological variations. One theory now blames cosmic rays: Perhaps one wings in occasionally from outer space, smacks into a gene—and the gene is never the same again. The first zebra, for example, may have resulted from a ray hitting the proper gene in a horse! END

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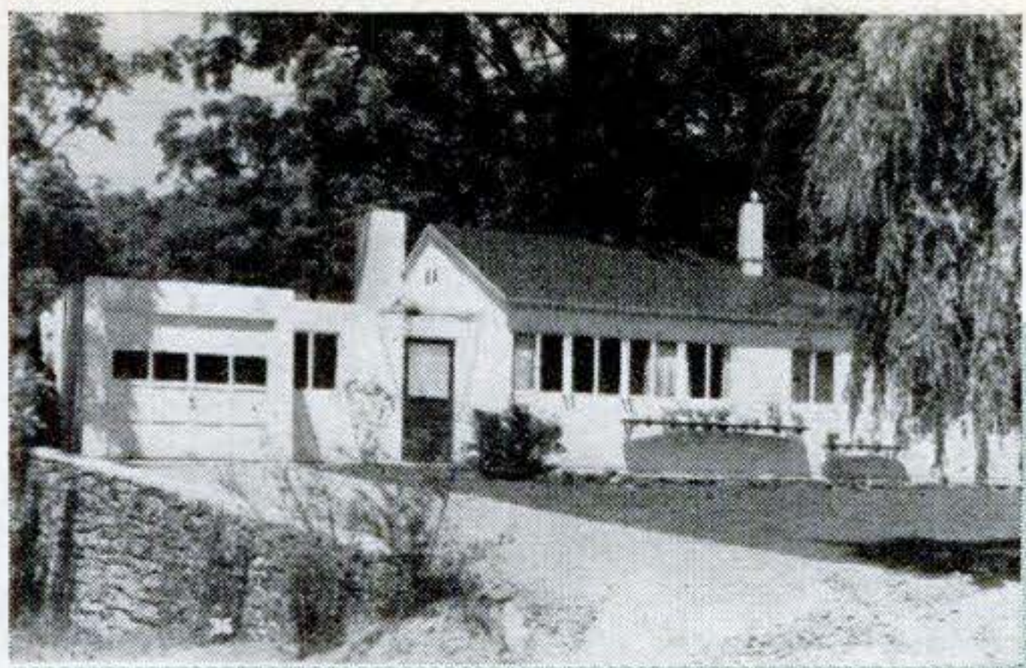
Housed in STEEL

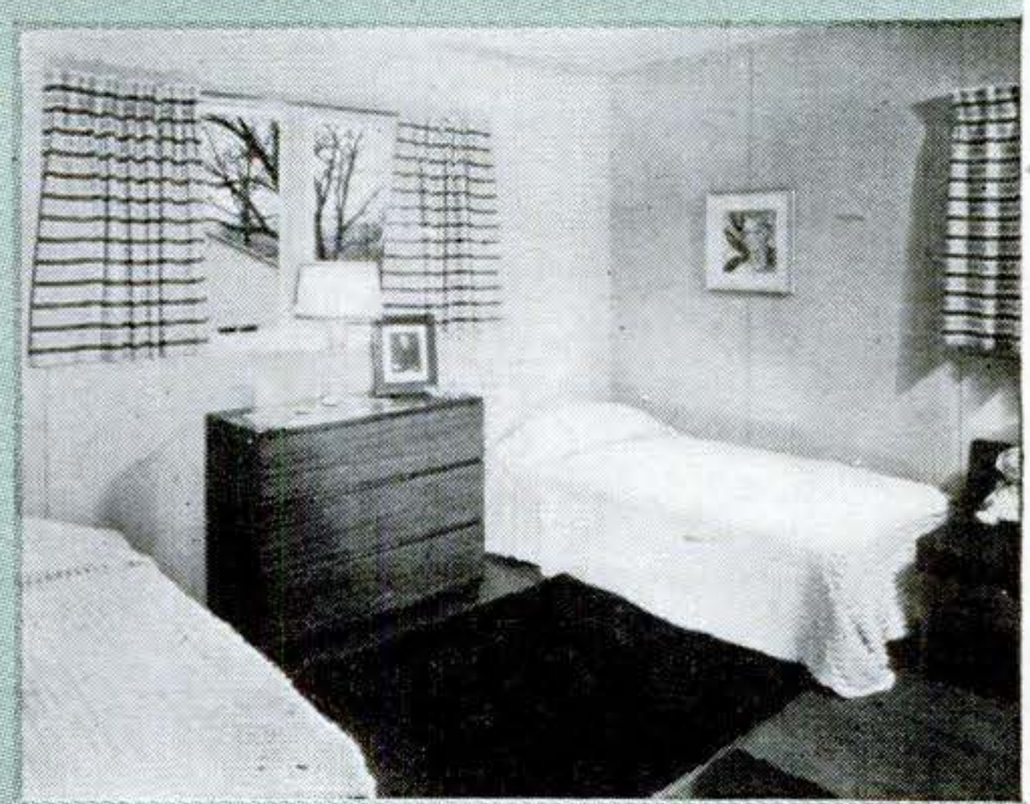


This three-bedroom Harman house, the "Overbrook" model, has been in use for more than a year It has a combination living room-dining room.

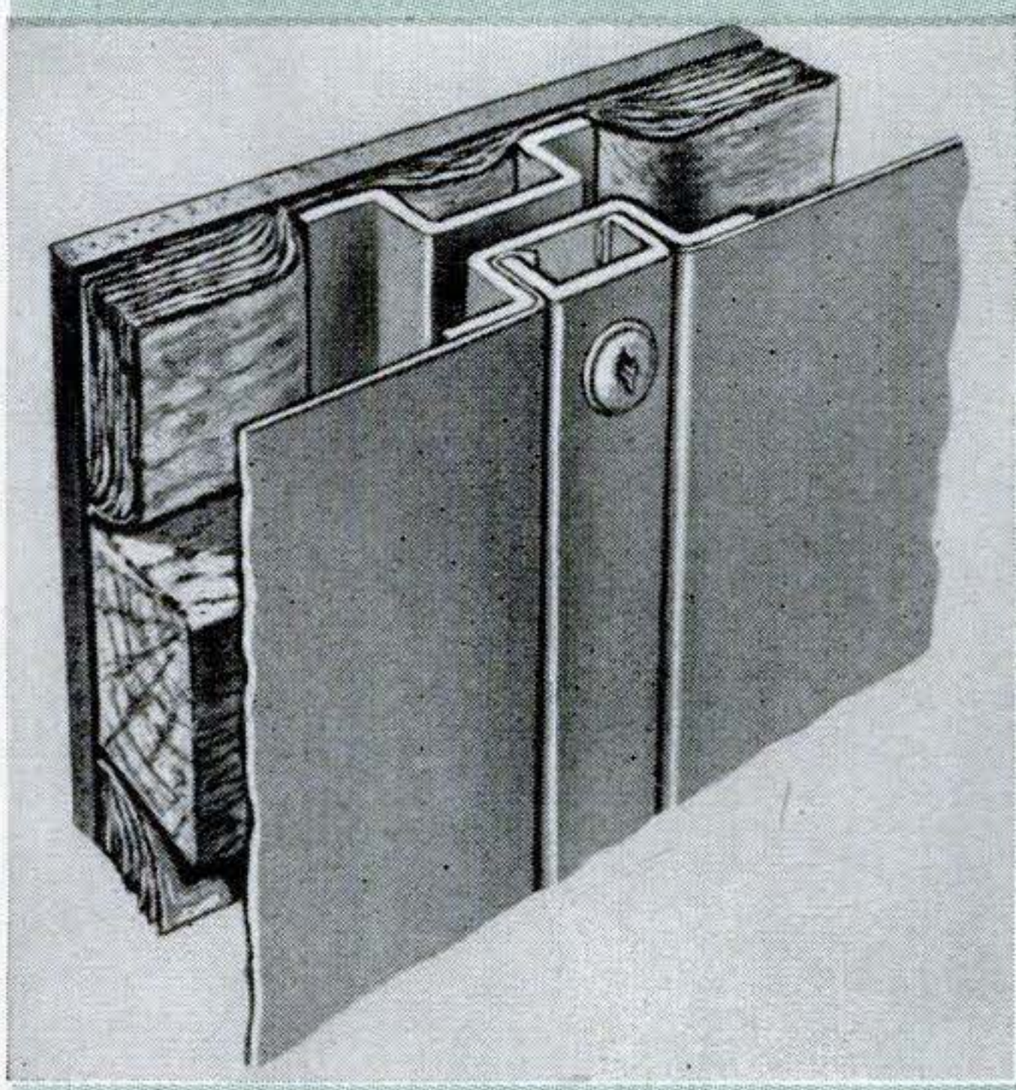
MASS production of 10,000 steel houses in 1947—a new home every eight minutes when the assembly line reaches full production—is the goal of the William H. Harman Corp., of Wilmington, Del.

Built in a wartime shipyard, the houses are to be sold for $3,250 to $4,080 f. o. b. factory, depending on the model. Initial schedules call for the production of eight semimodern and colonial designs in two- and three-bedroom types. The houses, which can be assembled in a few days once the foundation is prepared, contain complete plumbing, heating, bathroom and kitchen equipment, except for a refrigerator.

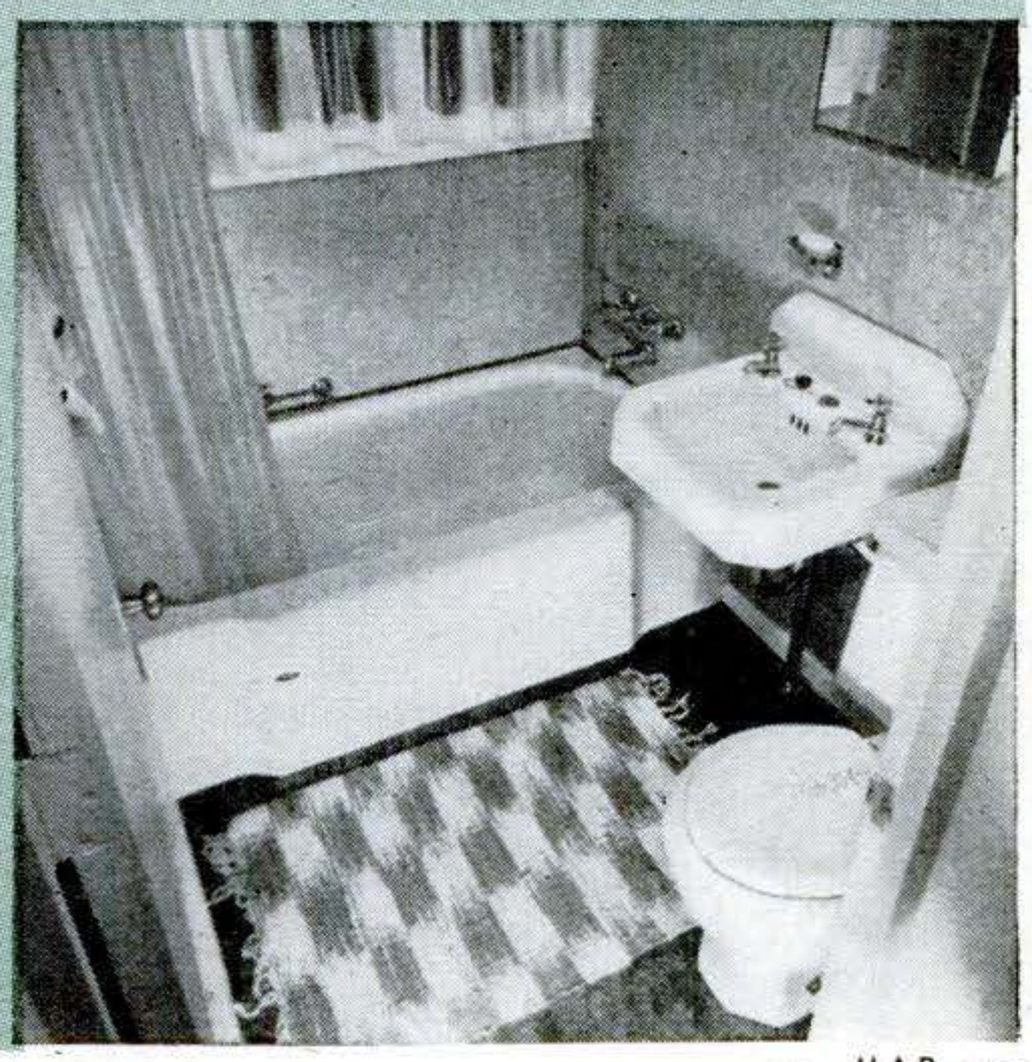
A rear view of the house shows its patio, behind the storage room, and the garage, which can be added to any Harman model if desired.



The window arrangement in bedroom, above, provides ample wall space and plenty of light and air.



Cutaway of wall shows construction details: First the steel exterior panel, then air space, insulation and interior wall. The last two are fastened to furring strips, one of which is visible at lower left.



A typical bathroom installation, at right, illustrates the built-in fixtures. The piping is precut.

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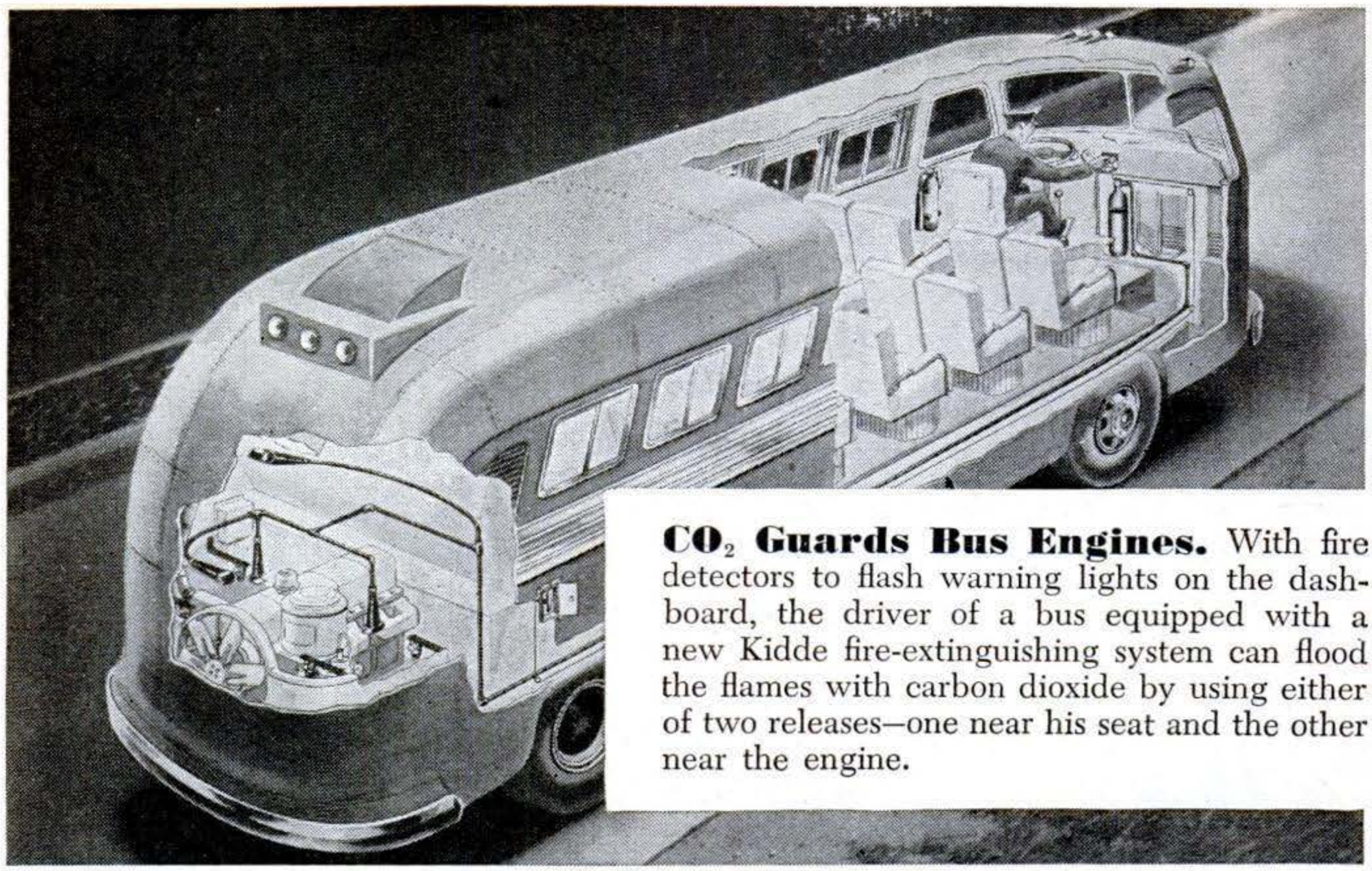
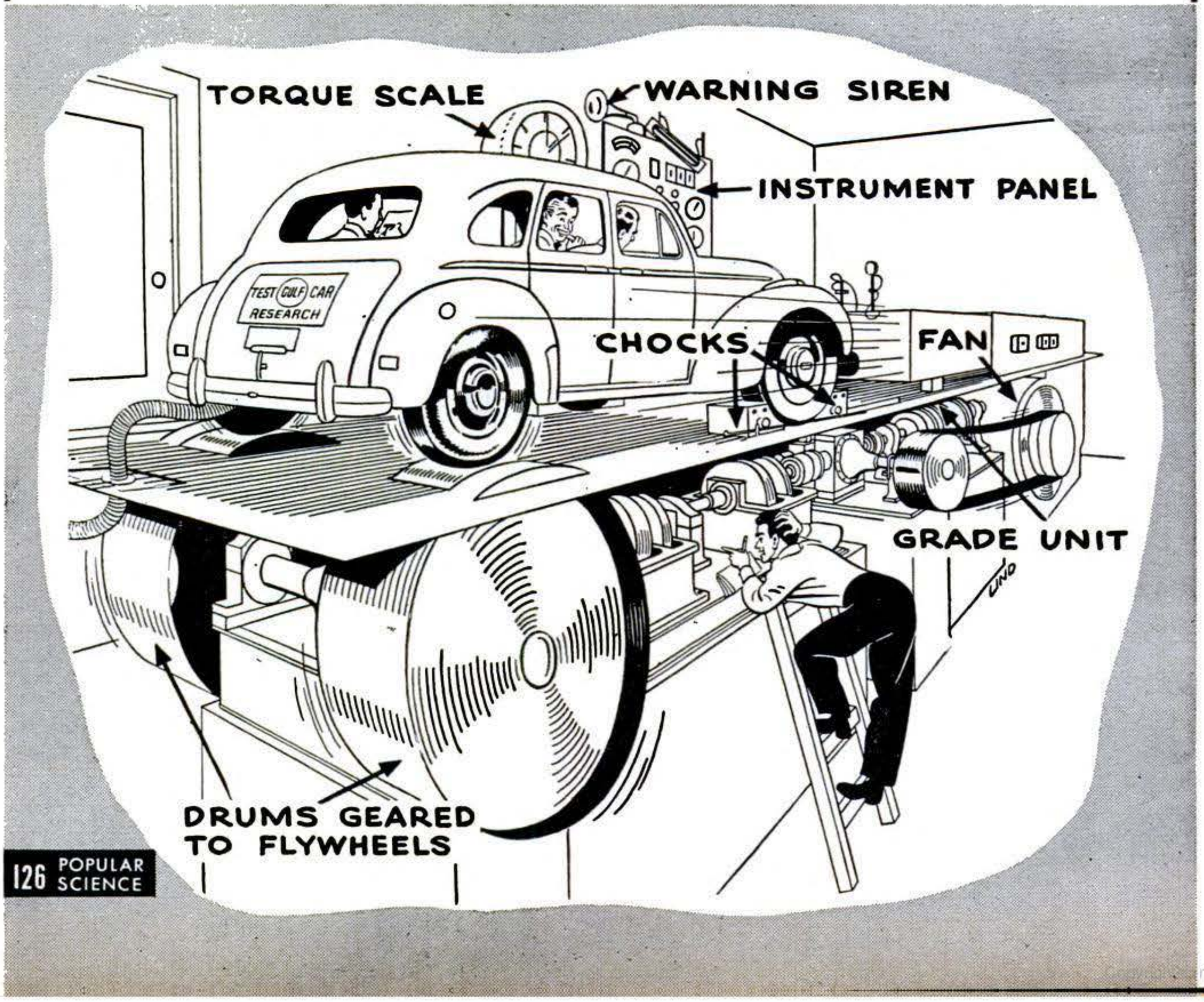


CO_2 Guards Bus Engines. With fire detectors to flash warning lights on the dashboard, the driver of a bus equipped with a new Kidde fire-extinguishing system can flood the flames with carbon dioxide by using either of two releases—one near his seat and the other near the engine.

Going Nowhere at 70 m.p.h. The illustration below shows how the Gulf Oil Company's "roadless road test" (PSM, Dec. '46, p. 90) works. The rear wheels rotate drums through which flywheels impose varying load conditions; electrical units create artificial grades; a fan blows a 70-mile breeze, and instruments record everything that happens.



Let Magnesium Lift It

War-proved, the lightest structural metal is better fitted to make everyday things.

THE things we lug around—tricycles, lawn mowers, furniture, even pianos—have weighed too much for years. But from now on, things are going to be lighter. For they will be made of magnesium, the metal only two-thirds as heavy as aluminum and one-fourth the weight of steel.

Magnesium was discovered in 1808 and produced on a commercial scale by 1896. It is plentiful—it comes from the world's biggest mine, the ocean. It is sturdy enough to support the 140 tons of a B-36 slamming down on the runway.

But this treasure lay neglected a full half

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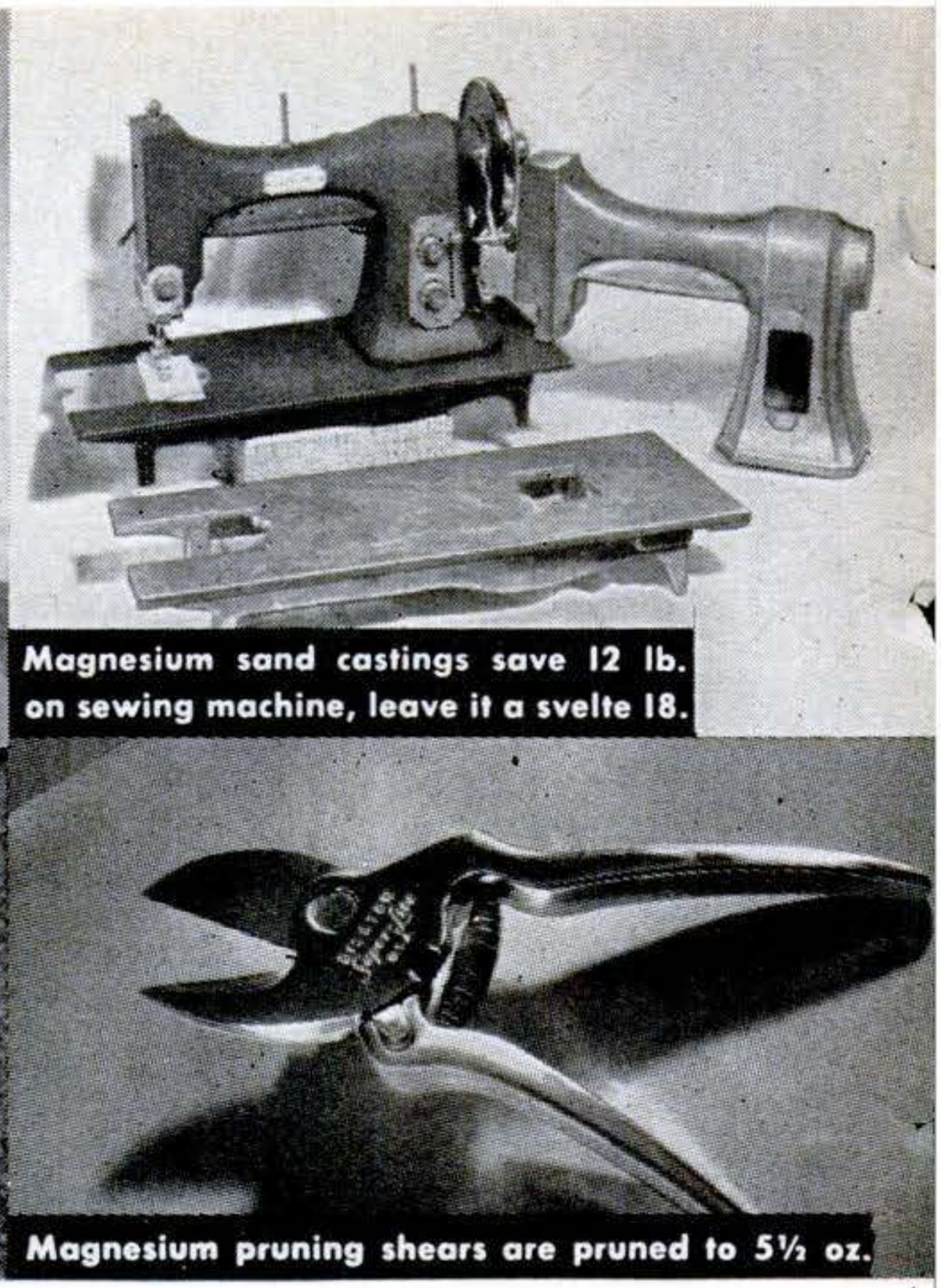
Magnesium slims this "Strolite" collapsible baby stroller down to only seven pounds.

Weight of lawn mower is halved by magnesium in wheels, roller hanger, gear casings.



Magnesium sand castings save 12 lb. on sewing machine, leave it a svelte 18.

Magnesium pruning shears are pruned to 5½ oz.

century until a world struggle for survival forced us to realize what it could do (PSM, Dec. '41, p. 59). Magnesium's war record was convincing proof. Last year consumption was five times as great as in 1938. More important, half that output went into things for everyday use.

Already on the assembly line are stepladders that can be lifted with your little finger, baby carriages that are really light enough to carry, lawn furniture, canoes, rowboats, tricycles, pianos that can be moved without the help of a circus strong man, and many other products ranging from hamburger griddles to X-ray machines.

Before all these things could become available, however, engineers had to learn how to use the metal.

Magnesium is light, yes—lightest of all the structural metals—and in strength it ranks fairly high, although below aluminum and decidedly inferior to steel. This disadvantage can be overcome in most cases by making a magnesium part bigger to add strength. That naturally cuts into the weight saving, but for many applications where little stress is involved and strength is a minor factor—magnesium is a natural.

Two of its weaknesses demand careful attention from designers. Magnesium is particularly susceptible to continued rubbing (bearing friction) and to shear stresses, forces which try to strip threads from a bolt hole or pull a rivet through sheet metal.

If you bought one of the first magnesium lawn mowers, you may have learned about the effects of bearing stress the hard way. The wheels sometimes developed a drunken wobble after a few weeks' use because the axle, rubbing directly against the magnesium wheels, quickly wore their holes out of round. In the present models, inserts of special bearing metal take that friction and the mowers work perfectly. Excessive shearing stresses are eliminated easily by using enough rivets to distribute the load and by avoiding fine, easily stripped threads.

Magnesium is more resistant to corrosion than ordinary steel, although it does not possess aluminum's fortunate ability to form its own tough, corrosionproof film. Like steel, it can be protected against oxidation by paint. Methods for chromium plating it are now being perfected.

The corrosion caused by salt water and food acids affects magnesium, but not much more than it attacks aluminum and cast iron. According to its producers, there is no reason why cooking pots, magically light, could not be made of magnesium. It is perfectly suited to frying pans and griddles, since it distributes heat quickly and evenly

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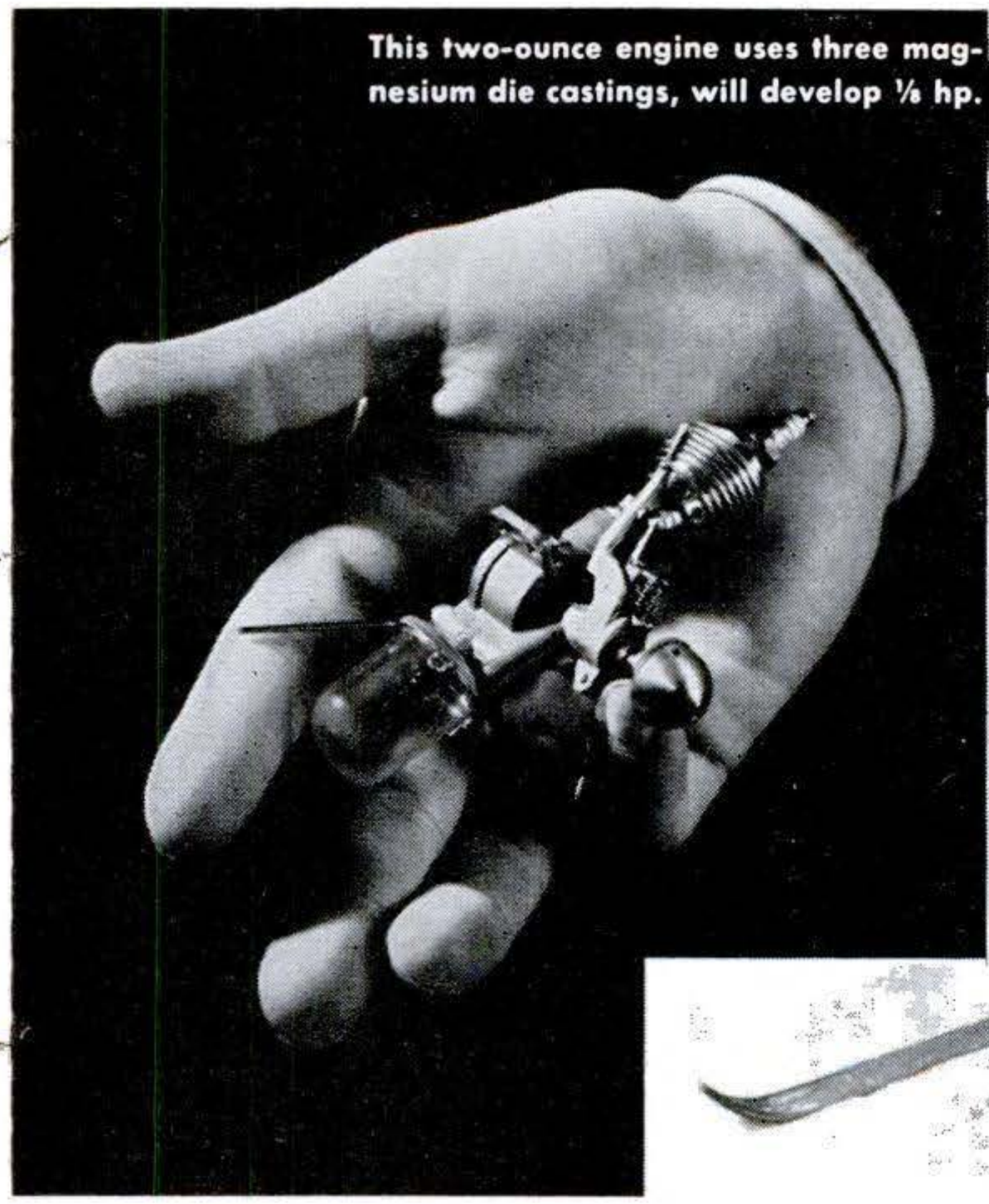
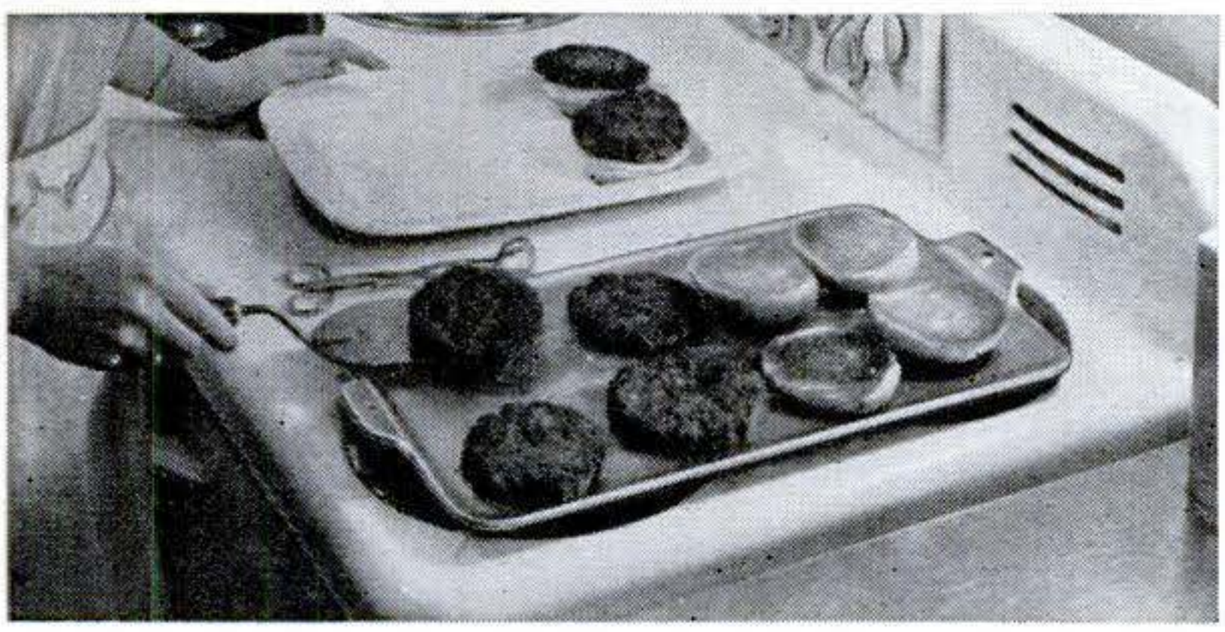


This two-ounce engine uses three magnesium die castings, will develop ⅛ hp.

Frame of big-league catcher's mask is magnesium.

Lightweight skis—magnesium made.



Magnesium griddle covers two burners and browns food evenly over entire surface.

and is not affected by greases. Half a million families are already browning pancakes and hamburgers on magnesium griddles.

The griddles should help lay to rest an old bogey that has haunted magnesium for many years—the fear of fire. After watching a housewife turn on two hot gas jets under a griddle, you'll stop worrying about your magnesium baby carriage suddenly bursting into flame. It can't happen, because magnesium conducts heat too well to burn.

To be sure, magnesium in powder form, or in thin shavings, or melted, will burn quickly, and the flames are difficult to put out. This characteristic has been put to work in photographic flash powders, flares and incendiary bombs. It creates a hazard in plants working with the metal. Molten magnesium must be covered with an air-excluding film of flux powder or noninflammable gas while being cast. The dust from grinding wheels must be sucked away to safe containers by blowers. Fine chips from lathe work must be swept up frequently.

While magnesium is safe, strong and light, one more quality is necessary for widespread use—economy. It costs a third more than aluminum by the pound, but volume for volume it is cheaper than any other metal except iron. Even when more expensive, magnesium's weight saving may cut costs enough to justify the investment.

Magnesium truck bodies offer a striking illustration. One model costs twice as much as a steel body, but can carry two tons more. The extra two tons on every trip can save enough money to pay off the extra initial expense within four months.

The practical dollars-and-cents advantage of magnesium is rapidly expanding its industrial use. That means more production, a lower price, leading to still more production, and so on in a descending spiral. Some authorities believe magnesium will soon be as cheap per pound as aluminum or steel.

Certainly it can never become expensive because we want too much of it. The supply in sea water alone is inexhaustible—ten million pounds to every cubic mile—and its

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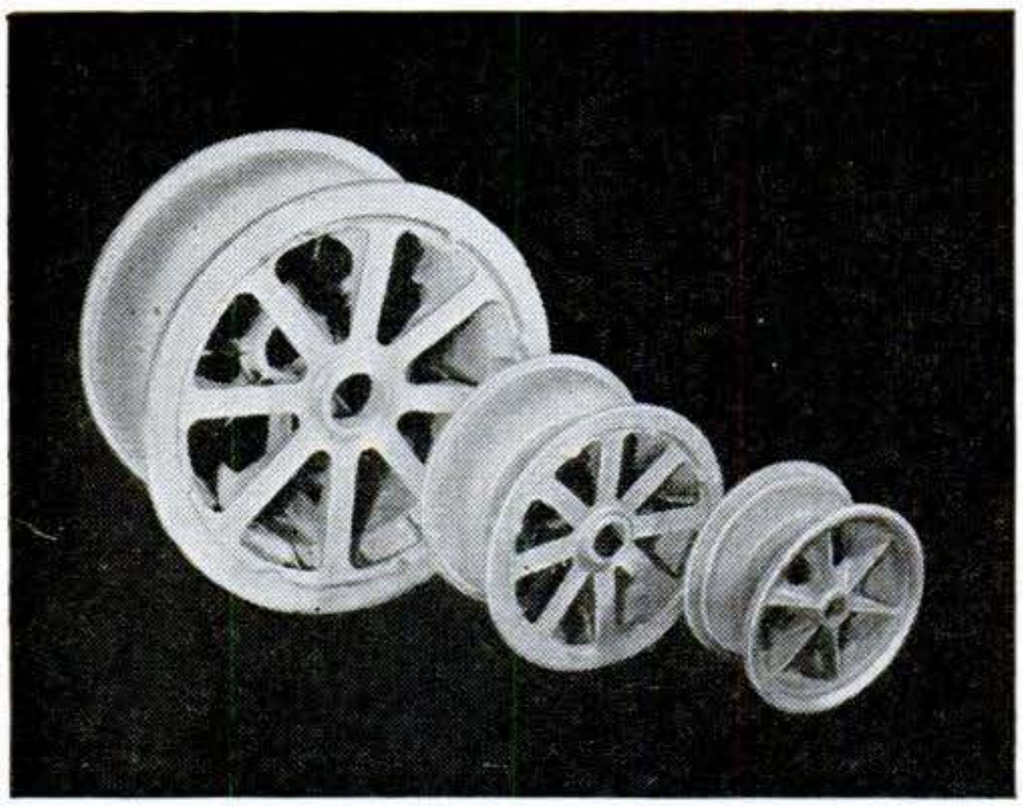
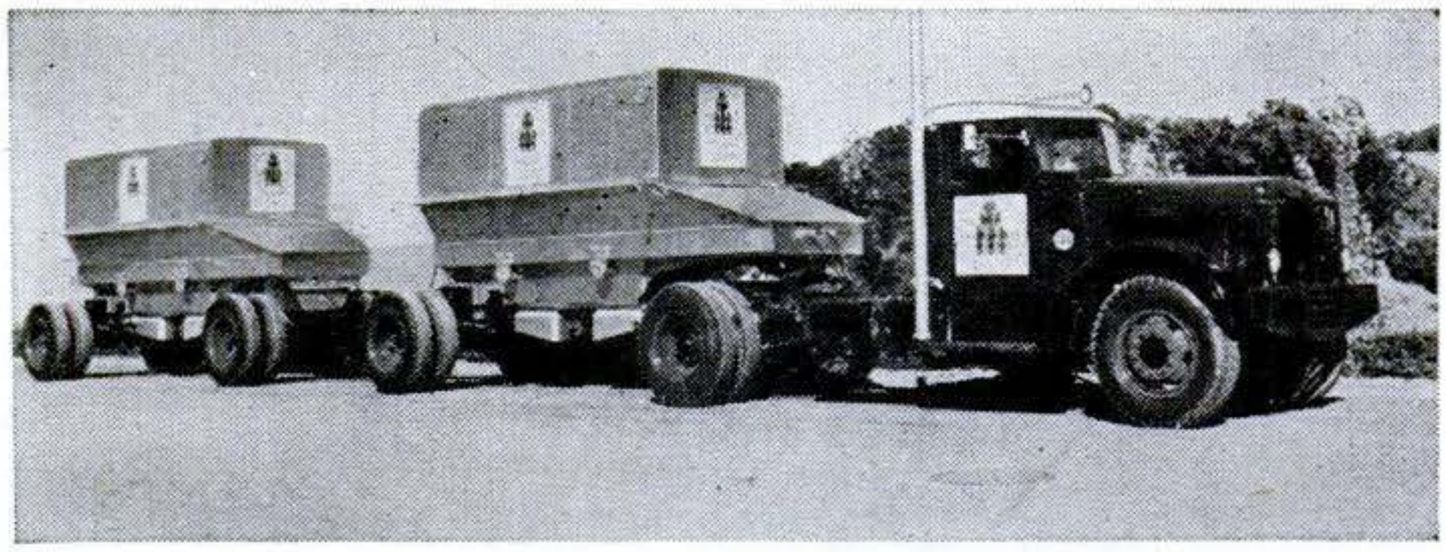


Light weight and resiliency make magnesium a natural for plane landing wheels.

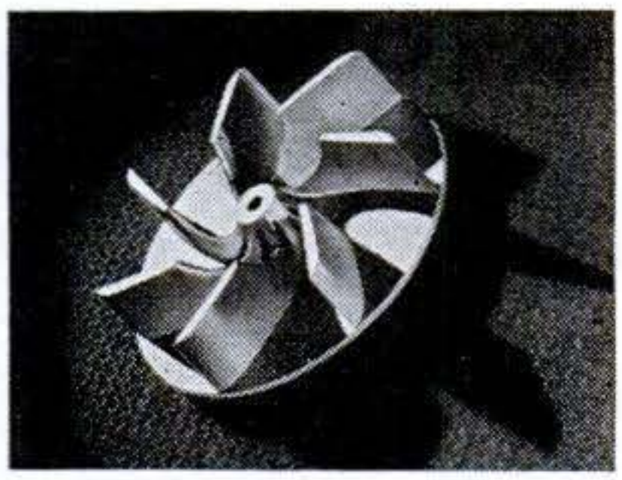
solid ores are more plentiful than any other metal except iron and aluminum. Several efficient methods have been used to get magnesium from these solid ores, while the Dow Chemical Company has a neat process for mining the metal from the ocean.

With so much magnesium potentially available, the demand is finally catching up to the supply. Apparently it took the jolt of a war to overcome the public's reluctance to accept this new metal. But that inertia has been overcome. This year should see more than 50 different magnesium products on department-store counters. END

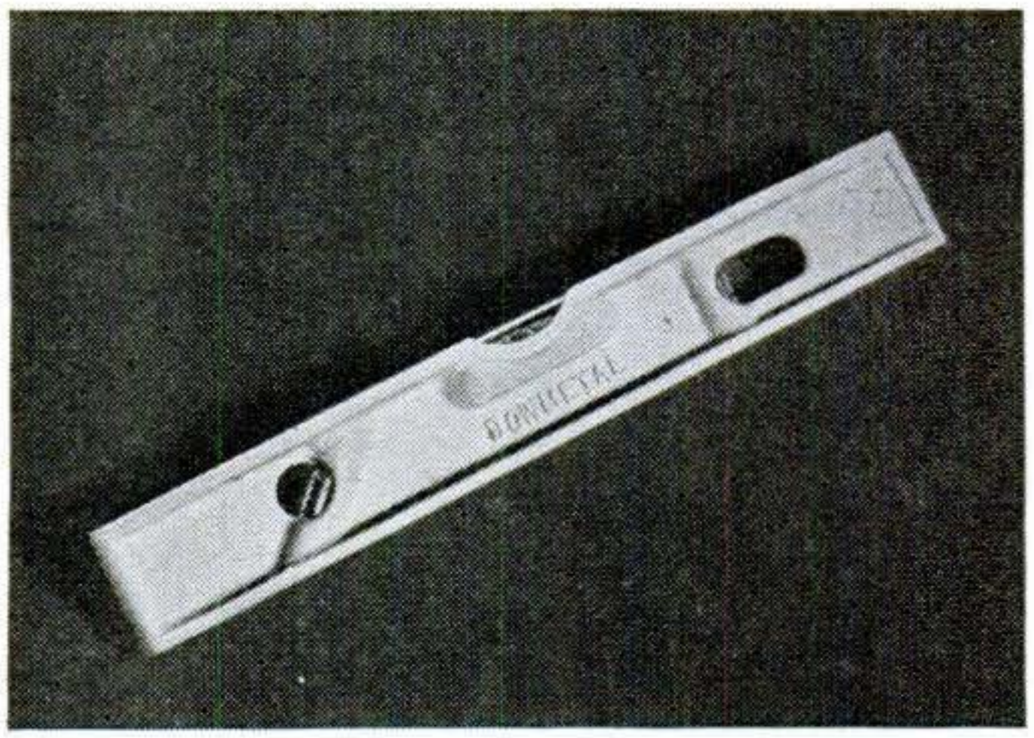


This all-magnesium truck train carries three extra tons.

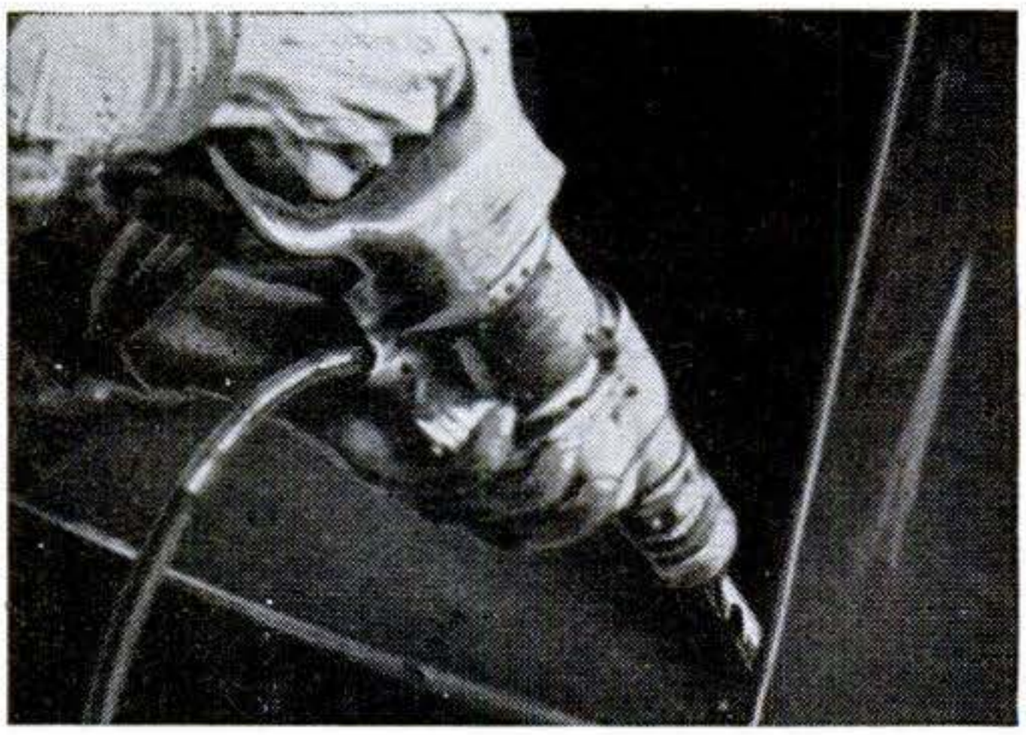
Aluminum and magnesium team up in 60-foot articulated bus.



This feather-light vacuum cleaner fan is made of magnesium alloy for higher speed.



Nine inches long, this carpenter's torpedo level weighs only three ounces—thanks to magnesium.



Magnesium works on the auto assembly line in the housing and handle of this electric hand drill.

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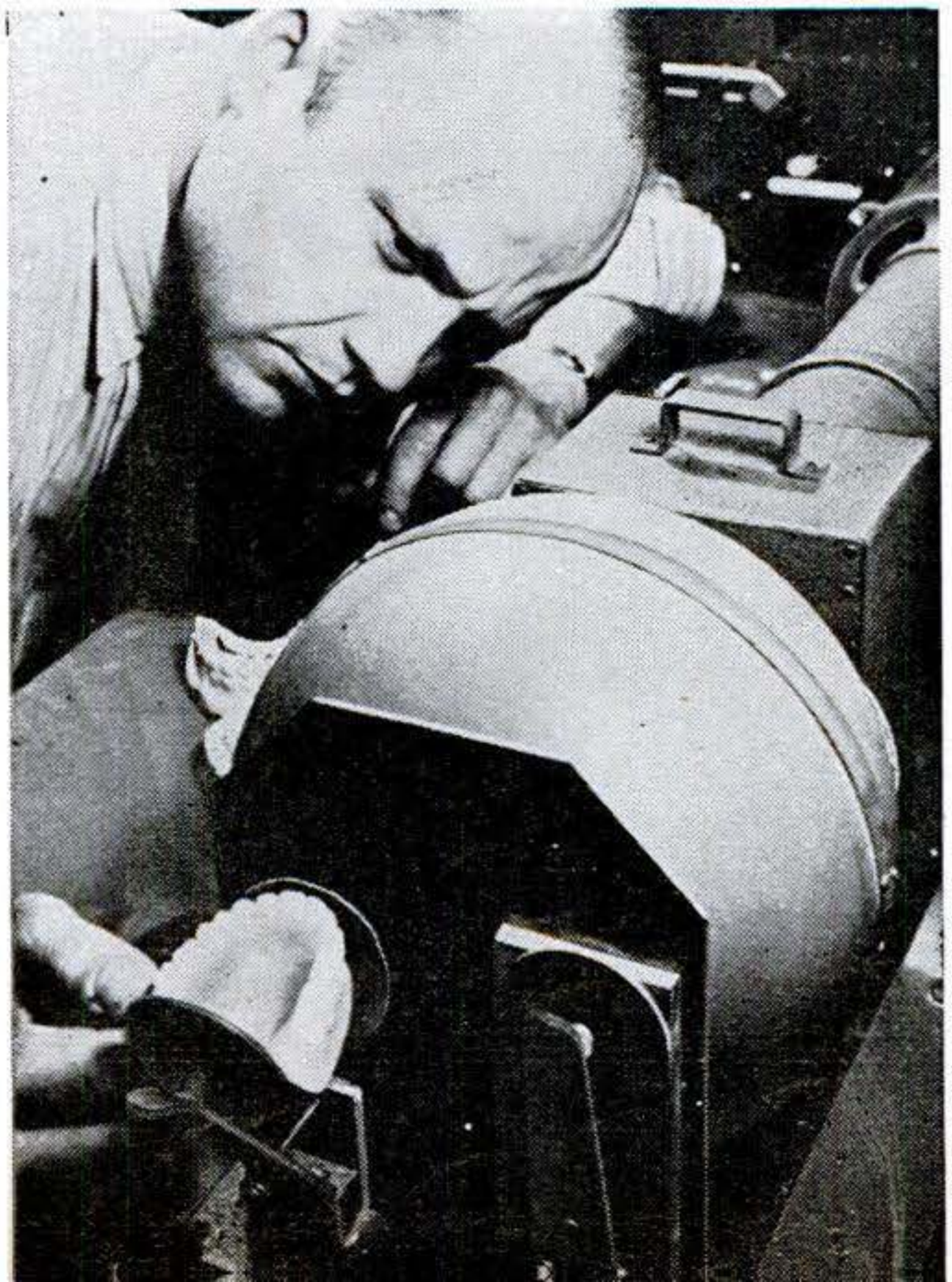
Bottling Machine Defies Bacteria. Faced with a growing demand for Parenamine, an amino-acid solution used for injections, engineers of Frederick Stearns & Co. designed this sterile filling machine to eliminate laborious hand work. The entire apparatus is enclosed by a Plexiglas hood and is subjected to a constant flood of bactericidal ultraviolet rays. The machine can fill 2,000 bottles an hour.

Color Detective. Standardizing the whiteness of false teeth is only one of the odd jobs of General Electric's spectrophotometer, shown below. Accurately measuring an infinity of shades, it tells good oysters from bad, analyzes lipstick in crime detection and solves Technicolor problems.

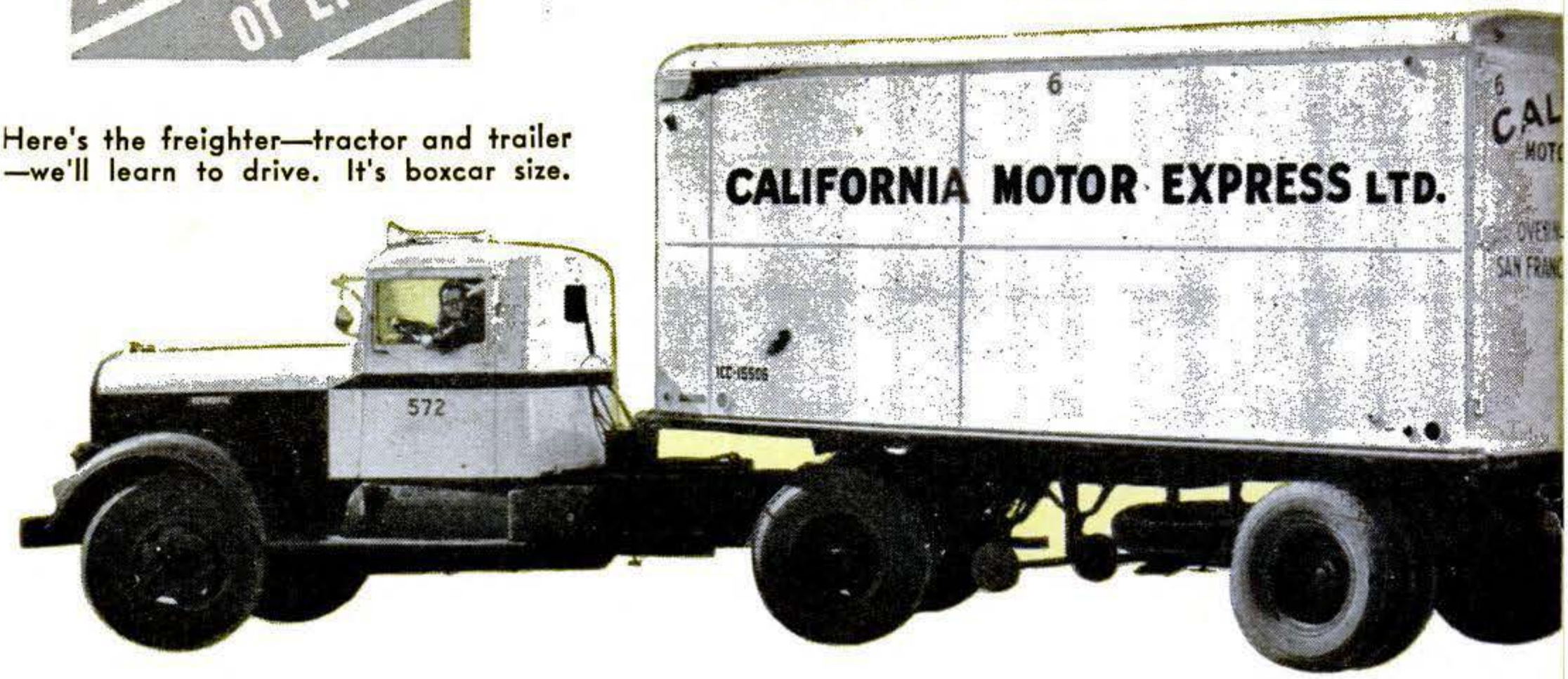


Bowling with Electricity. The electric-powered Whittle Rotobowler, below, flings an 18-lb. aluminum ball down a 94-foot carpeted court at speeds up to 100 m.p.h. in the latest variation of an old sport. The court (inset), with lighted hazard pins, resembles a giant pinball game.

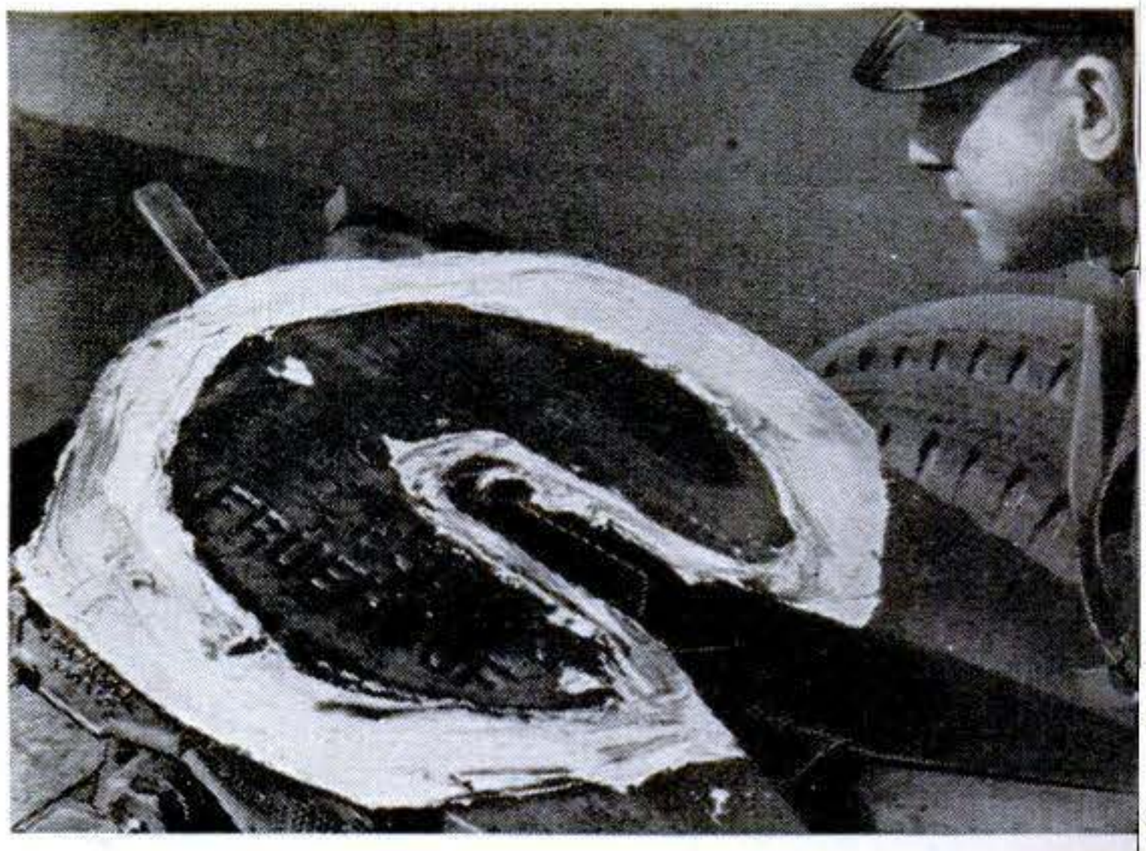
Mechanics of Living

HOW TO DRIVE A

Here's the freighter—tractor and trailer —we'll learn to drive. It's boxcar size.

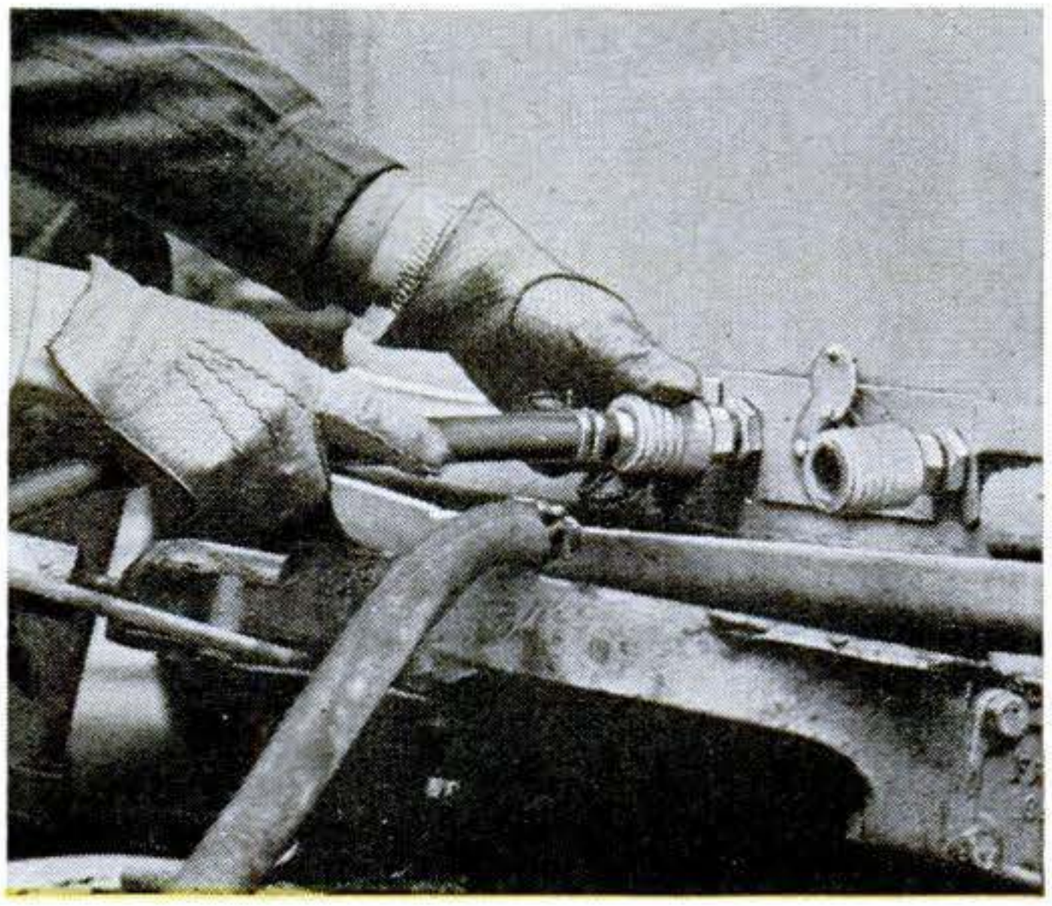


1. Our teacher is Edson Smith, twice world-driving champ. He checks warning flare to be sure it'll work. Rule No. 1: Inspect equipment.

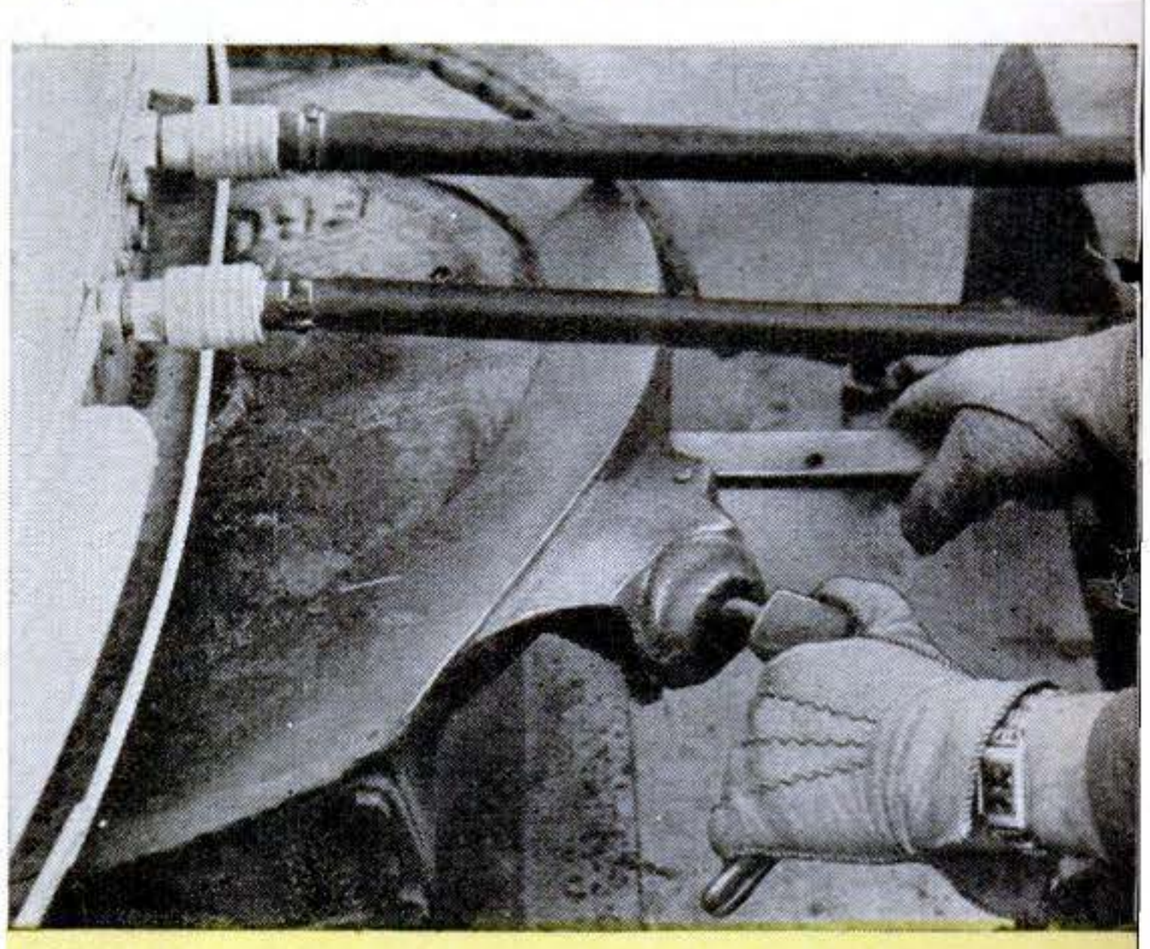


2. Tractor's fifth wheel gets a good going over. It's the baby that carries the front end of the trailer. Tires, fuses, bulbs, brakes are also checked.

3. Next, hoses running from tractor to trailer's brakes are connected. This is a vital operation because load will run amuck unless all brakes hold.



4. Smith pulls auxiliary lever with right hand as his left jerks hook that drops fifth wheel. Next step is to hook up tractor and trailer.



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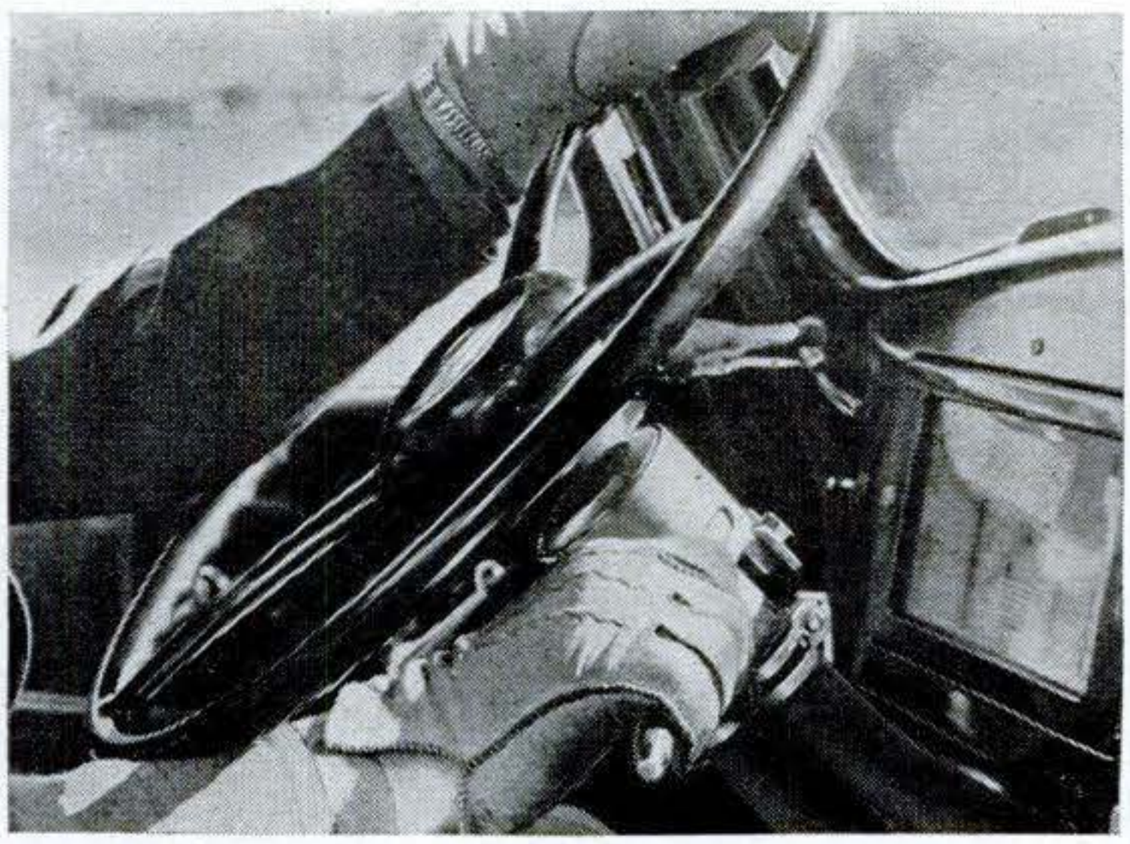
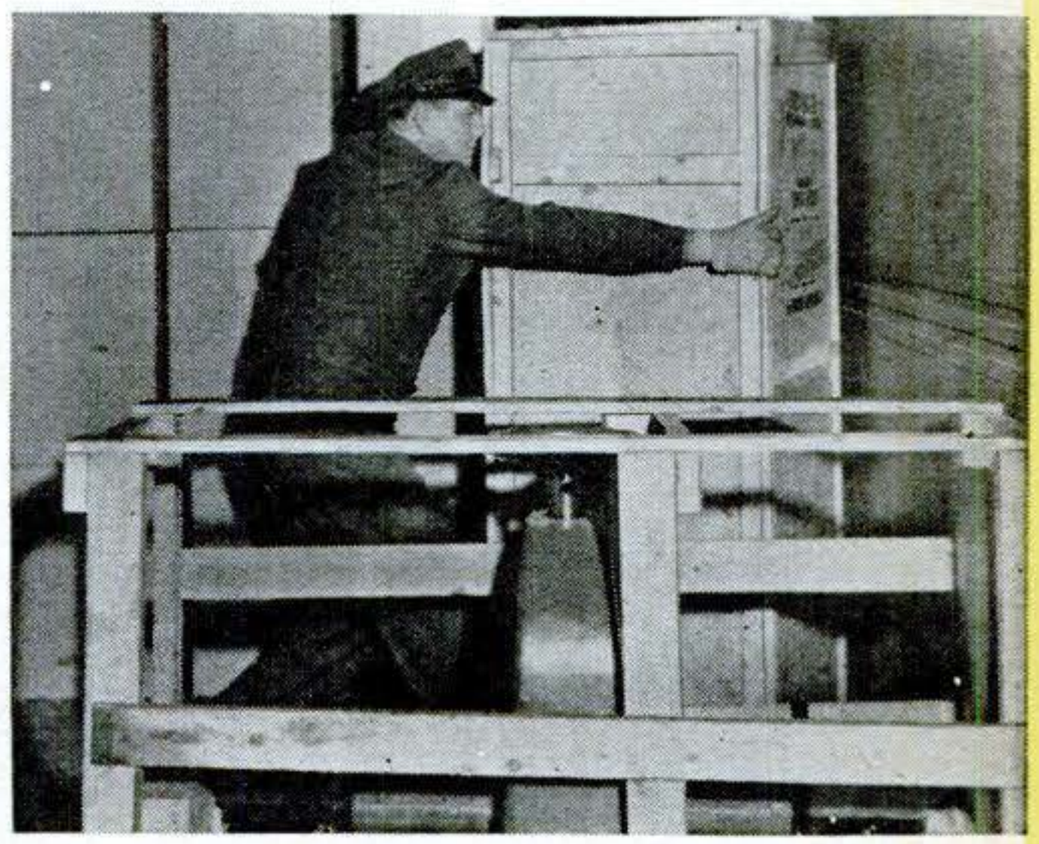
TEN-TON TRACTOR TRAILER

5. On the road. Smith is about to "take" the truck ahead. He looks into rear-view mirror, gives arm signal, eases to left, passes fast. When it's slippery chains are used on trailer and tractor wheels.



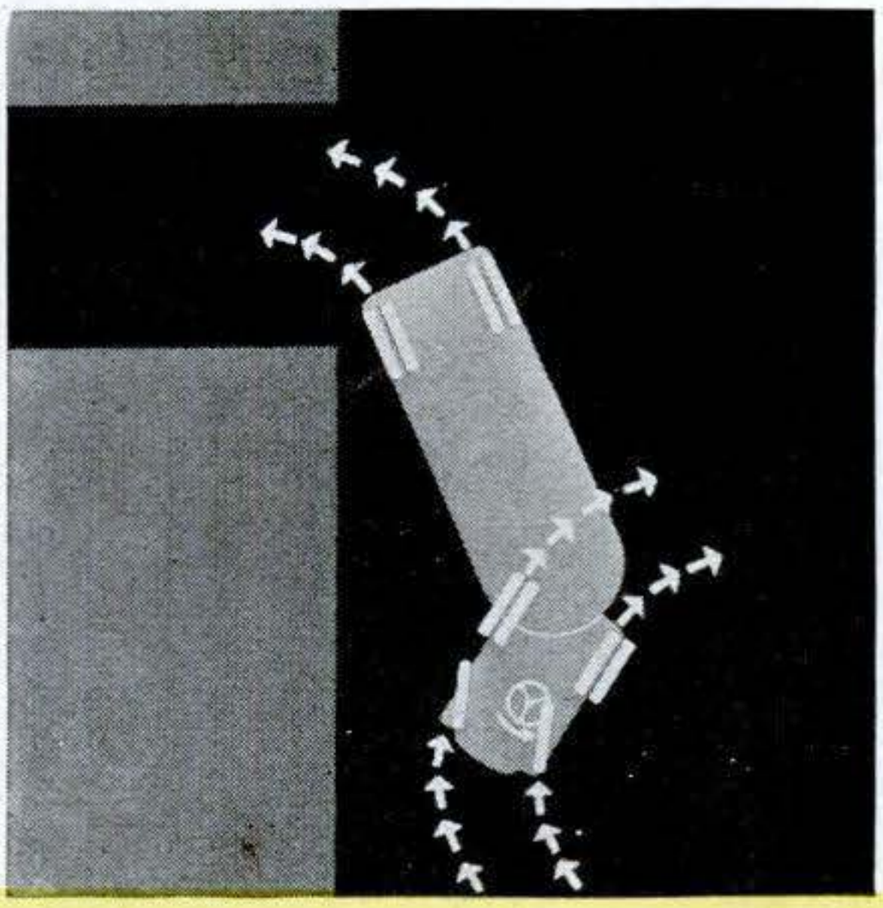
6. To stop, trailer brakes are hit first by pulling lever on steering wheel housing. If tractor brakes were applied first, trailer would fish-tail.

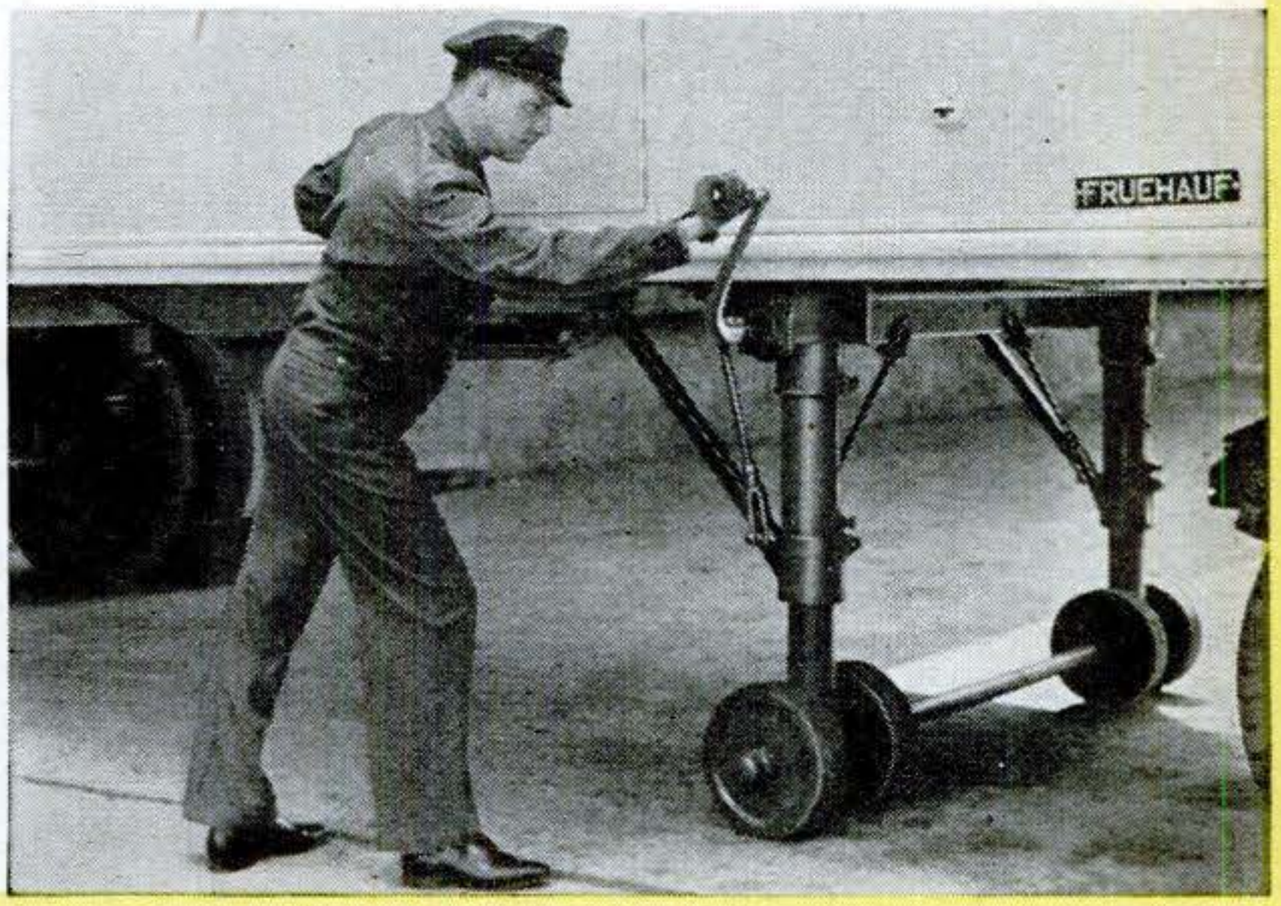


7. Now and then Smith stops and inspects his load. If it has shifted, he redistributes it. An unbalanced, shifting cargo could throw truck on curves.

8. Trip is over and Smith backs into unloading platform off narrow alley. Diagram shows how he stops ahead of target, backs with wheels cramped.

9. Before uncoupling, trailer's supports are cranked down. Huge freighters are seldom in accidents because their drivers know the safety rules.





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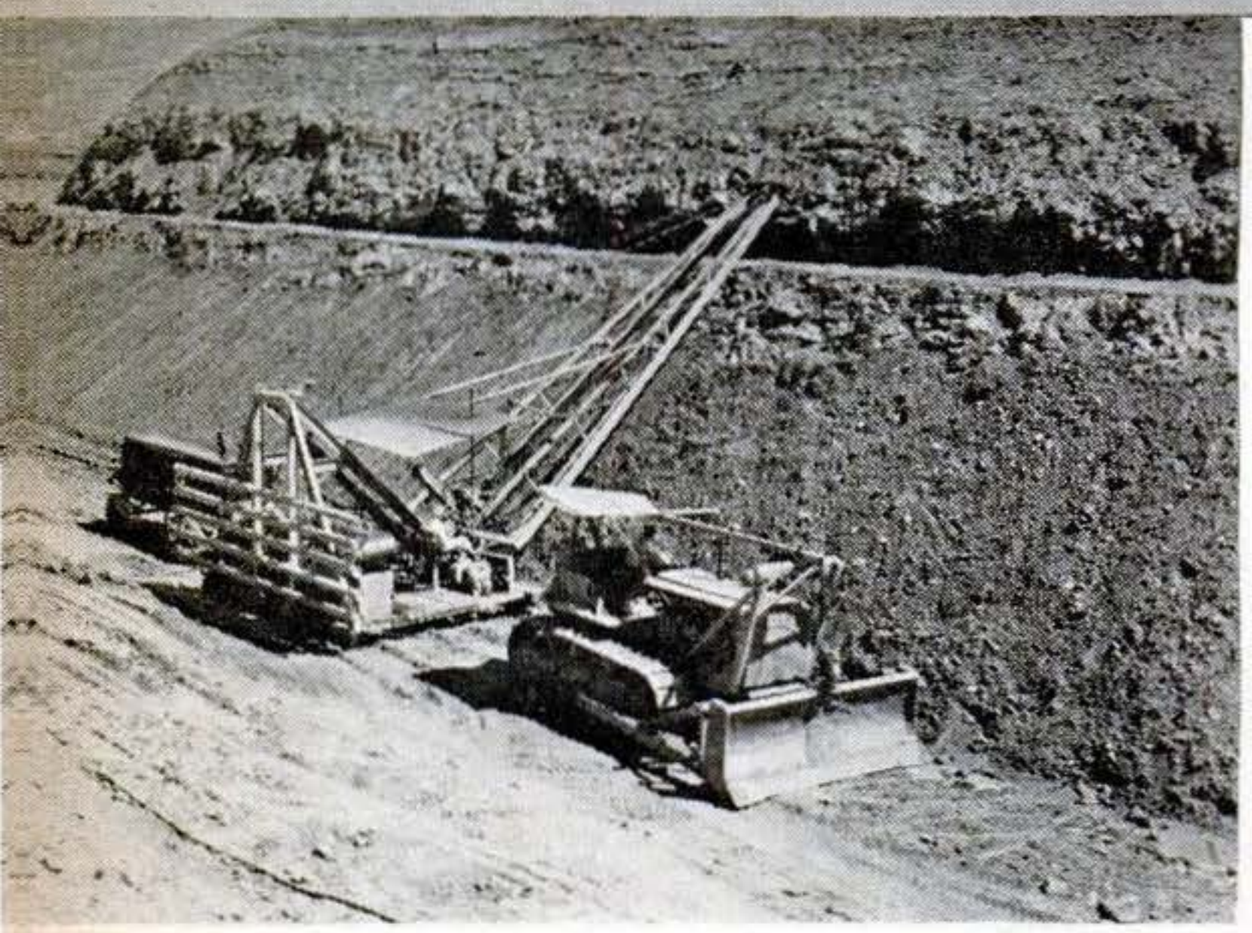
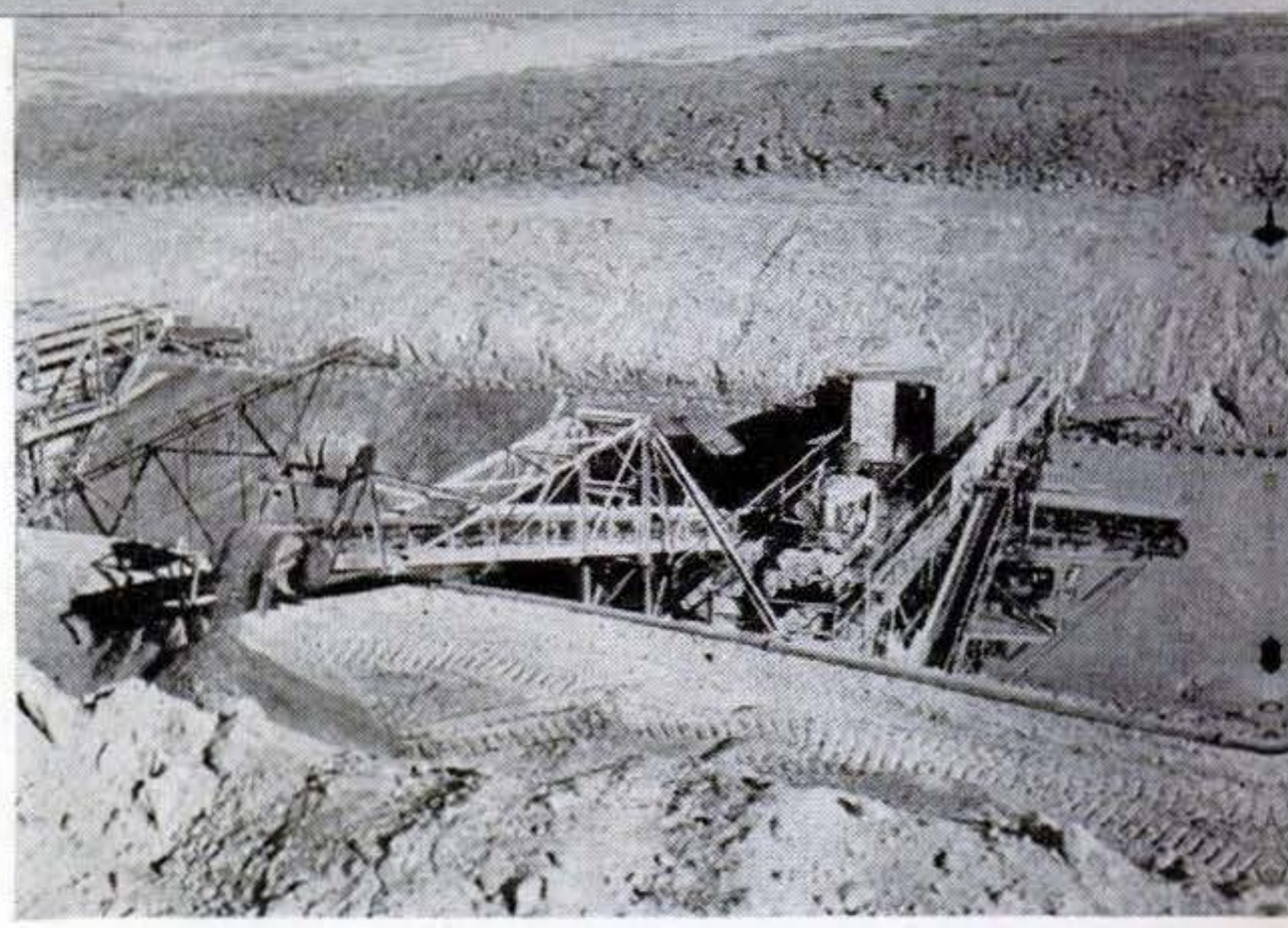
The track left by this advancing train of machinery will be the Friant-Kern Canal. It will carry the waters of the San Joaquin River 160 miles southward to the arid region near Bakersfield.

"TRAIN" Creates Canal

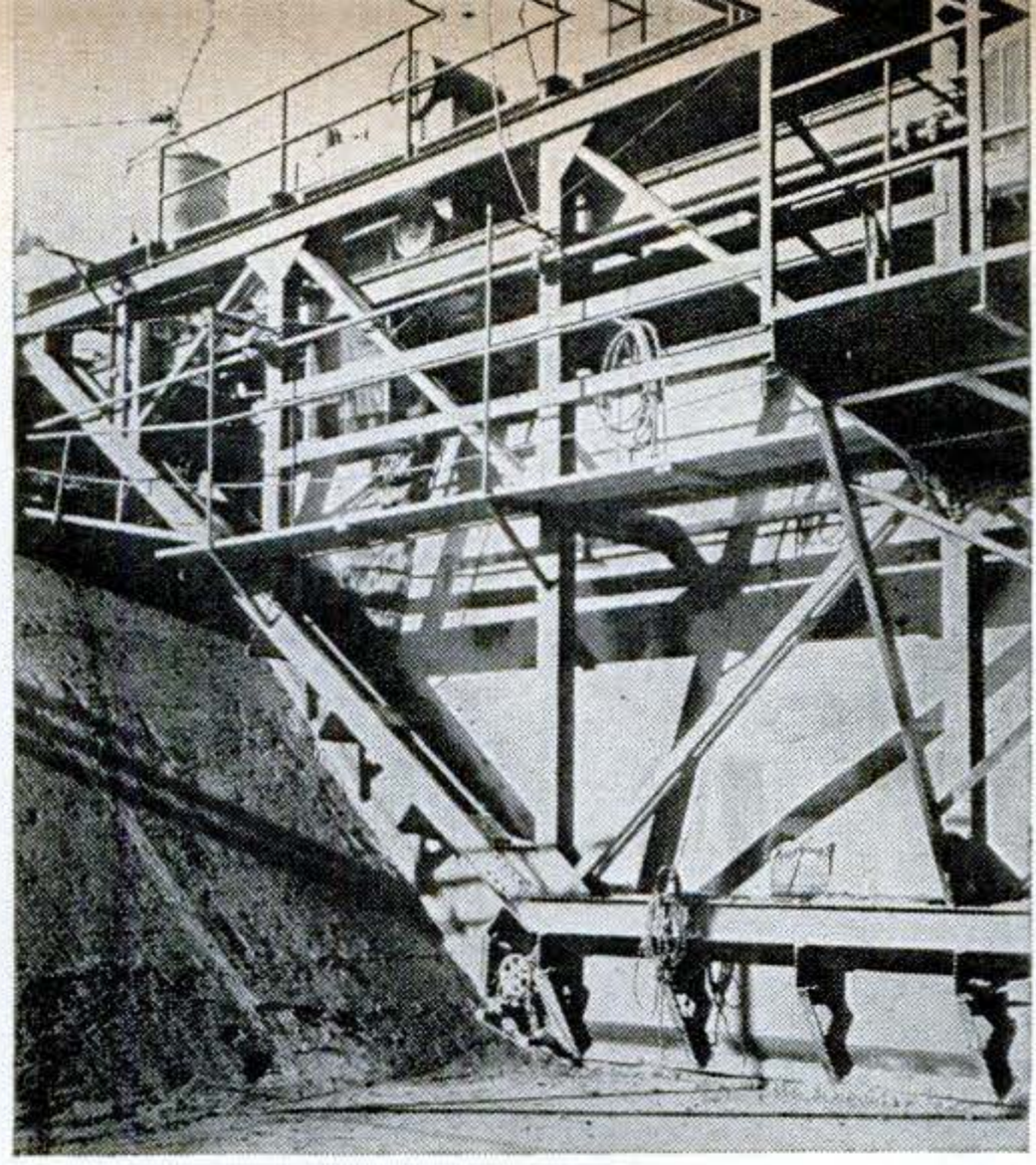


1. Although not an integral part of the train, this tractor-drawn tamper performs the first step of the finishing operation. A compressed-air hammer, riding on an adjustable boom, packs the sides of the canal to prepare them for the trimmer, which smooths the surface before concrete is poured.

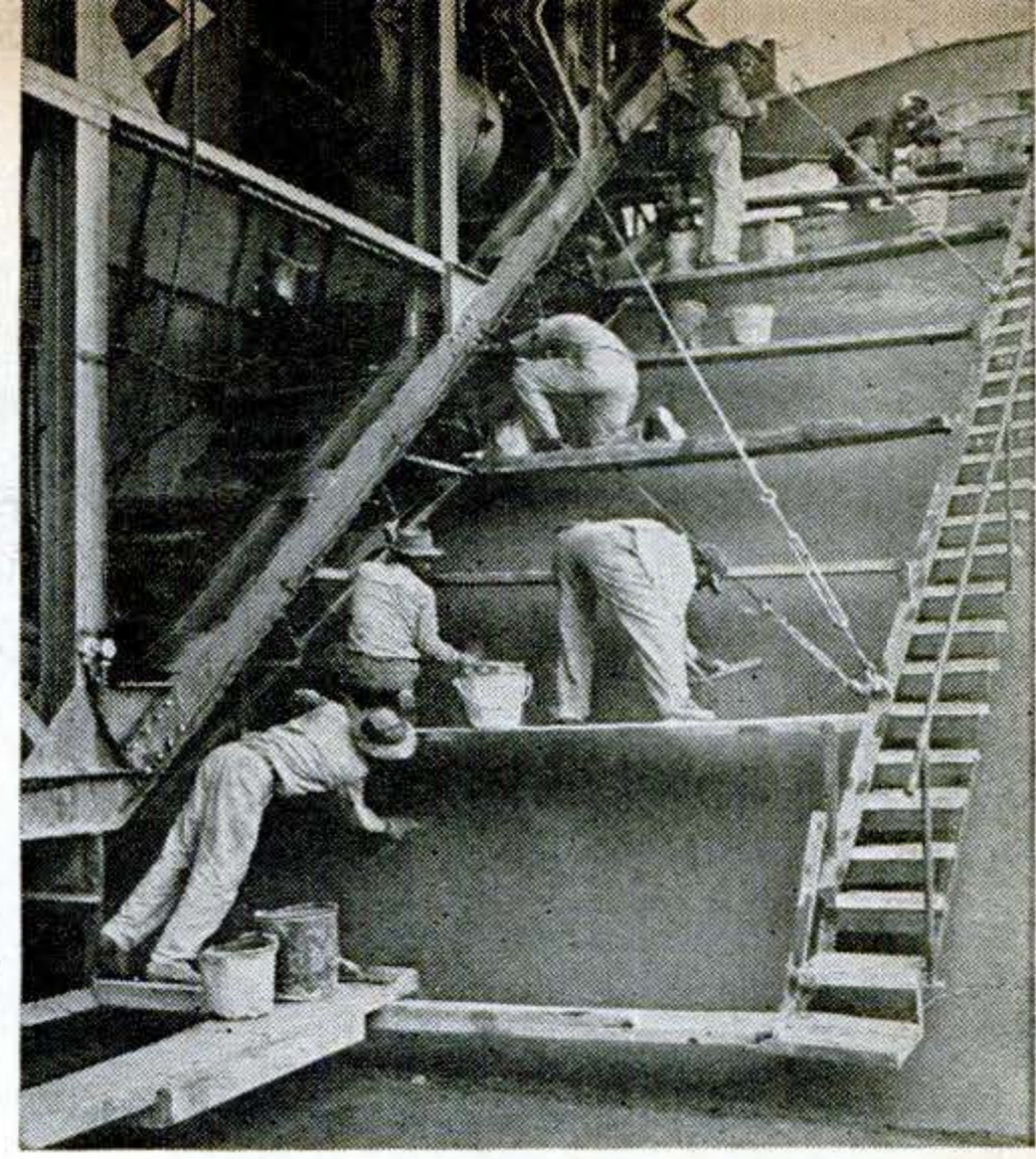


2. "Locomotive" of the construction train is the trimmer, above, riding on rails on each side of the canal while its two bucket chains scrape the packed sides. Self-propelled by tractor engines, it stands 36 feet high and is 85 feet wide. Following it comes a spray rig that wets down the earth.

3. Concrete mixer, at right, has a long boom that feeds aggregate into the concrete-laying jumbo, which is called a slip-form liner. A small bucket traveling across the front side of the liner dumps the concrete down onto baffles at the bottom. The baffles, in turn, force the concrete into an even layer over the entire surface of the canal.

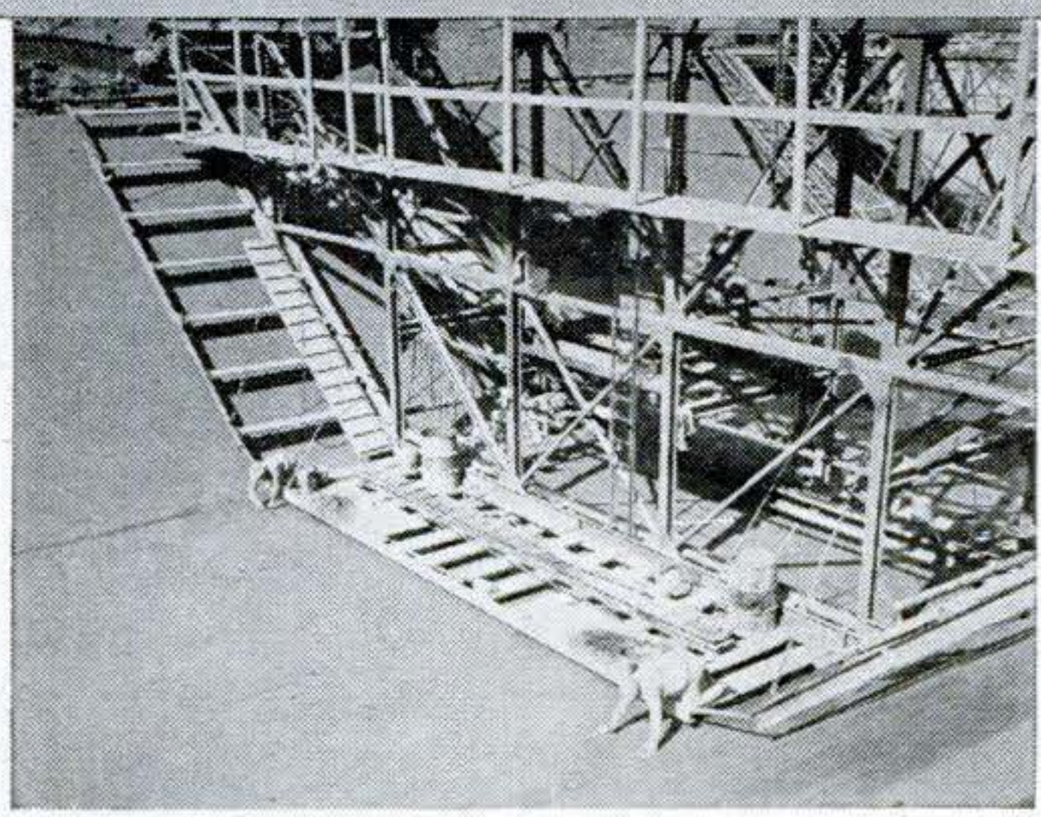


4. Front view of the slip-form liner. The dumping bucket rides on transverse tracks inside the frame.

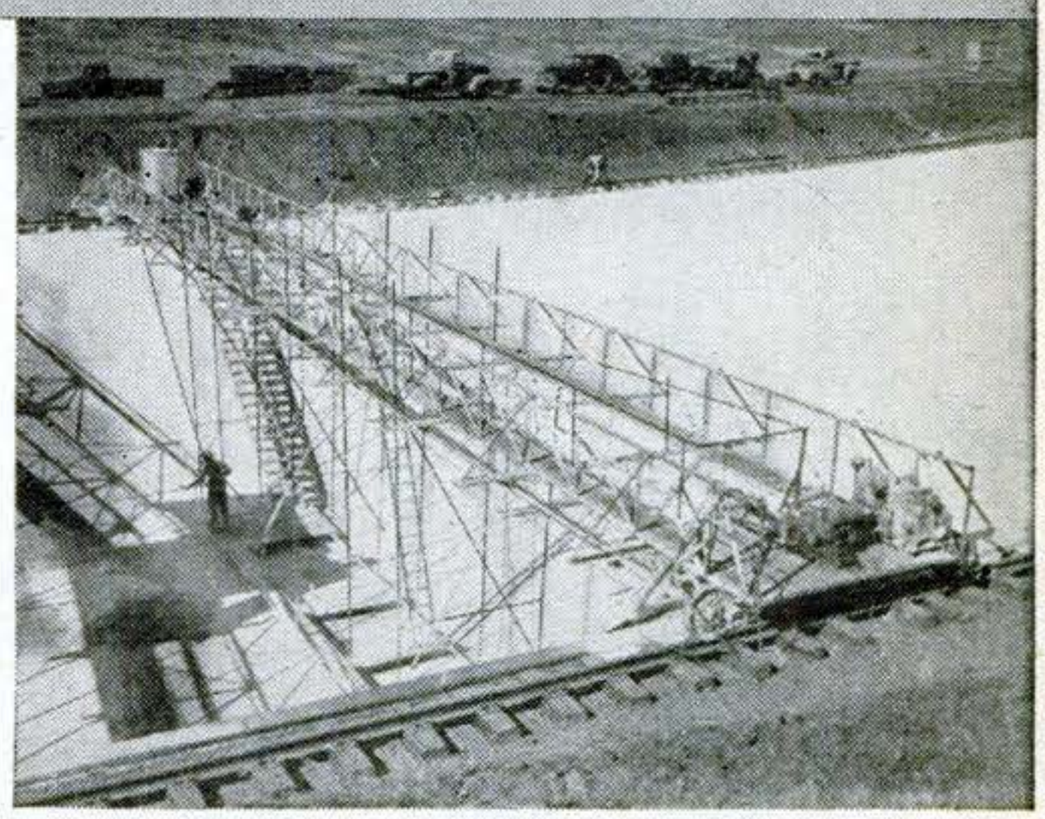


5. As the liner moves along, workers riding on its rear section finish wet concrete with hand trowels.

A GIANT TRAIN of unique construction machinery is grinding its way through central California. In a single continuous operation, it is trimming, paving and finishing a canal big enough to divert most of a whole river. Here is the train at work.



6. Two men on the front of this jumbo cut lengthwise expansion joints, machines cut transverse ones. A mastic rig then fills joints with caulking.



7. The train's "caboose." From this rig, painters spray on curing compound that helps dissipate concrete's heat, saves costly cooling installation.

8. A view of the canal, looking toward Friant Dam, shows part of finished concrete surface in place.

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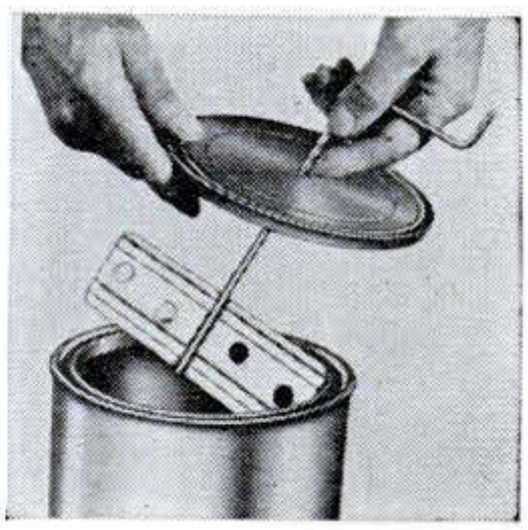
AIDS TO MODERN LIVING

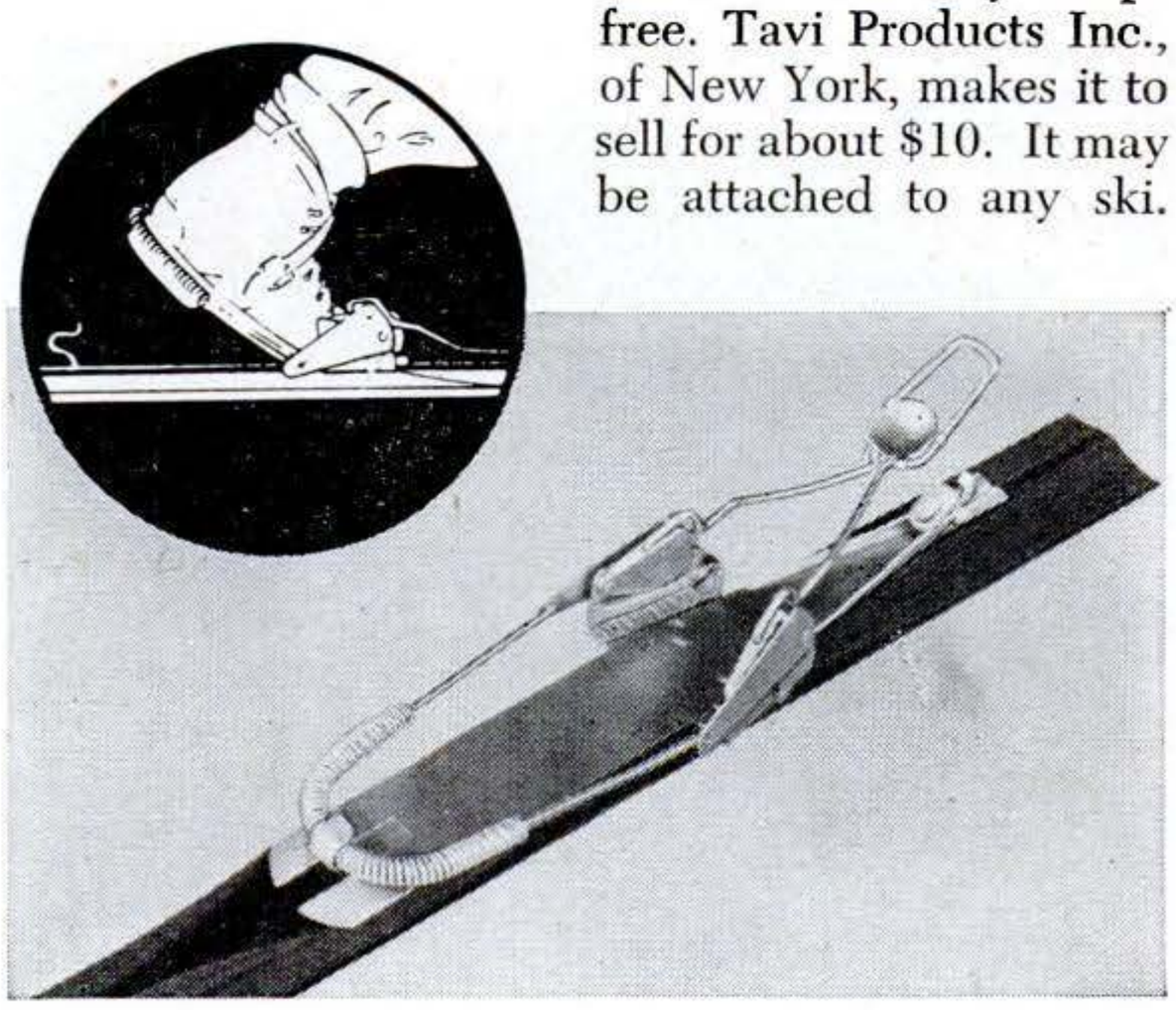
PORTABLE HEATER. An attractively styled home heater that will work off any 115-volt outlet has been put into limited production by Westinghouse to provide supplementary warmth anywhere in the house. The 5½-lb. unit is made of aluminum. Its resistance-heated element draws 1,250 watts.

PAY AS YOU LOOK. Small television receivers will shortly be made available for home use by Tradio Inc., of Asbury Park, N. J., at no initial cost to the subscriber. Payment is made by feeding a coin meter fifty cents for each half hour of operation. The receiver may later be offered on a fixed rental basis, and will also be installed in hotels and other public places. It is said to be the world's smallest television set.

SIMPLIFIED STIRRING. For mixing paints, Chadkin Sales, Inc., of Los Angeles, offers a perforated strip that is turned by a crank. A template centers the shaft in the can cover. It comes in quart- and gallon-can sizes.



SAFETY ON SKIS. A ski binding that spring-cushions minor shocks and automatically releases the boot under abnormal strain is said to be an answer to the most common skiing hazards. In a bad spill the foot instantly snaps free. Tavi Products Inc., of New York, makes it to sell for about $10. It may be attached to any ski.



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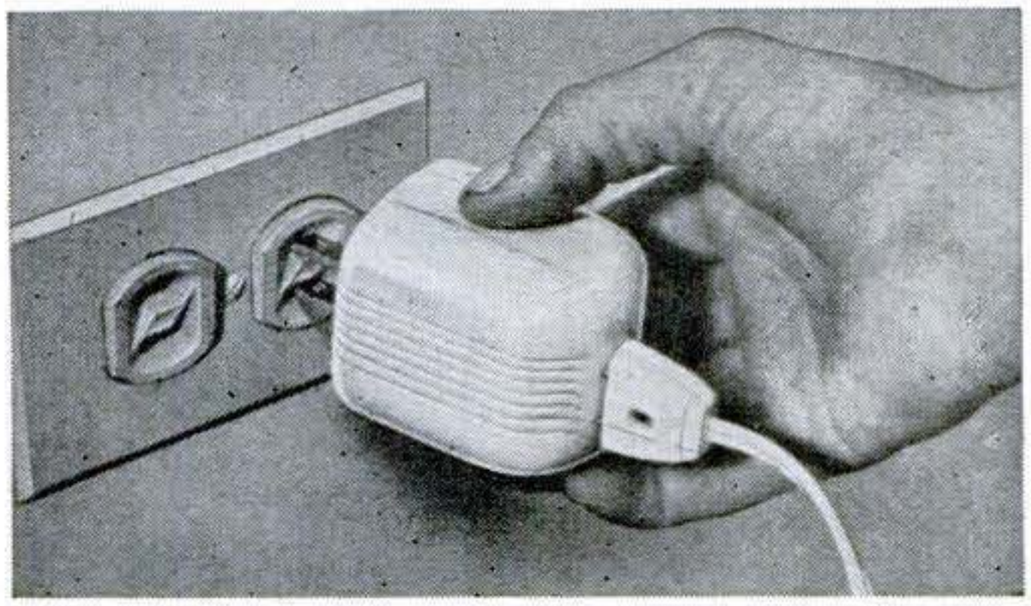
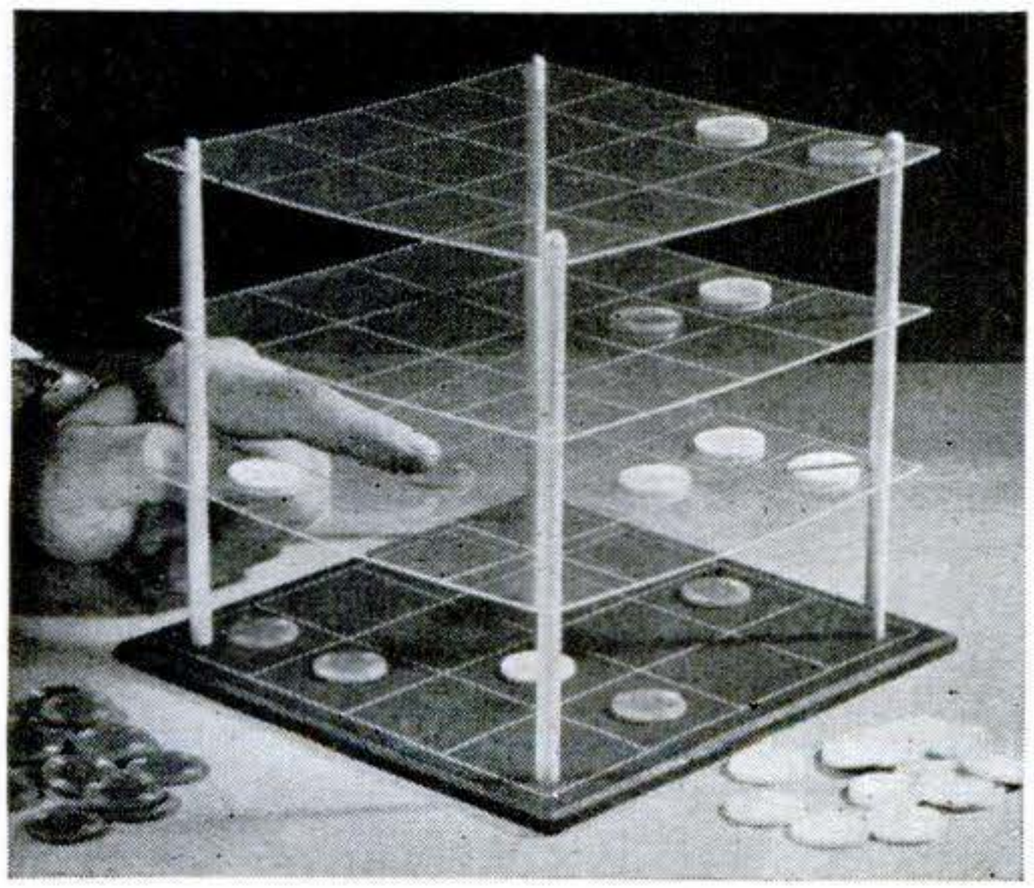
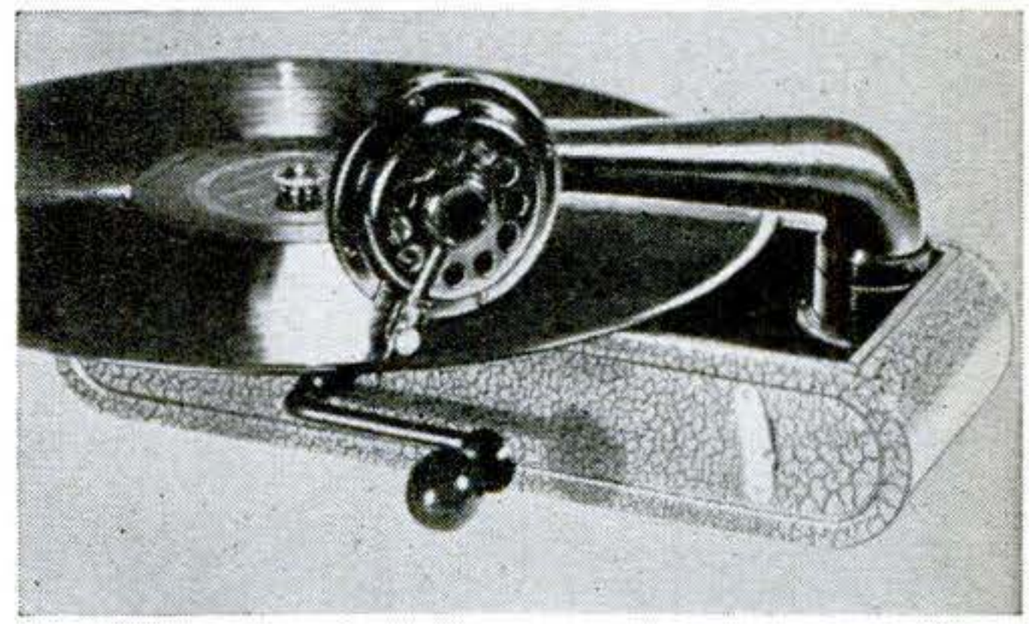
KITCHEN RADIO. Measuring 4″ deep, this unit, manufactured by American Communications Corp., of New York, mounts between studs so that its panel is flush with the kitchen wall. It has a clock, radio, and two receptacles. Louvers allow for the dissipation of heat. It comes in various finishes. Under $60.



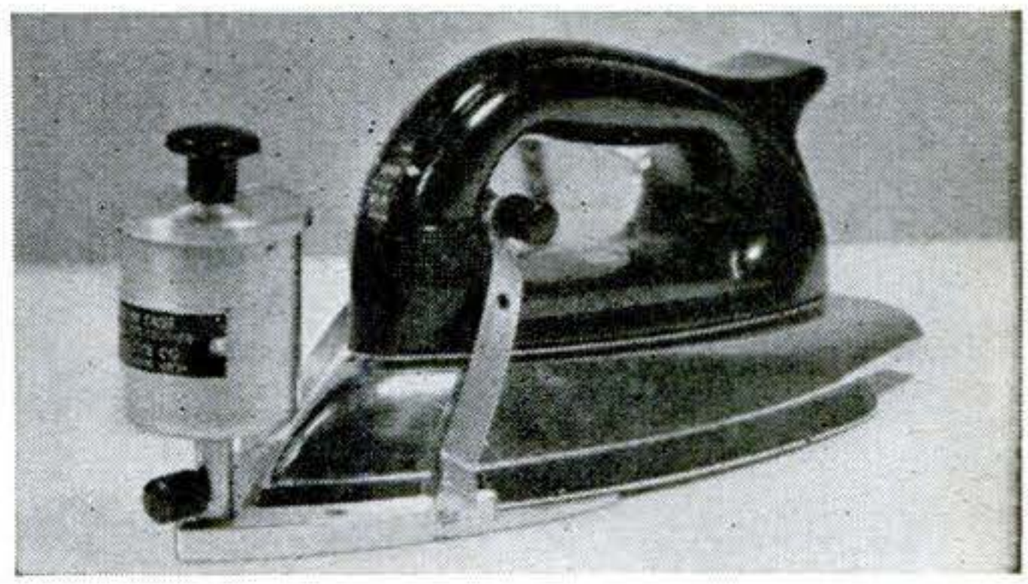
SHAVING EFFICIENCY. Electric razors usually perform better on D.C. To supply this current, Electronic Specialty Company, of Los Angeles, makes the small A.C. to D.C. inverter, above. It is housed in molded plastic and retails for $5.



MINIATURE PHONOGRAPH. From Switzerland comes the Thorens record player that folds away into a 2″ by 5″ by 11″ camera-model carrying case weighing a little over 5 lb. In tone and volume it is said to be comparable to full-sized acoustic phonographs. One winding of the motor is needed for each side of a 10″ or 12″ record. Rexon Inc., of New York, distributes the phonograph in the United States. Under $30.



STEAM PRESSER. Any electric iron can be converted into the now popular steam type by means of an attachment sold by Steam Fast, of Birmingham, Mich. The device consists of a sole plate and water cup, and sells for about $4.



THREE-DIMENSIONAL GAME. Ticktacktoe takes on extra space as well as interest when played on the "Qubic" board, left, made by the Duplicon Company, of Hopkinton, Mass. The four layers of squares consist of a hardwood base and three levels of transparent plastic suspended by aluminum corner posts. Three sets of molded plastic disks in different colors are provided as playing markers, allowing either two or three persons to participate in the play. As is the case with its simpler counterpart, the object of the game is to arrange the chips in a straight line in any direction either through or across the cube.

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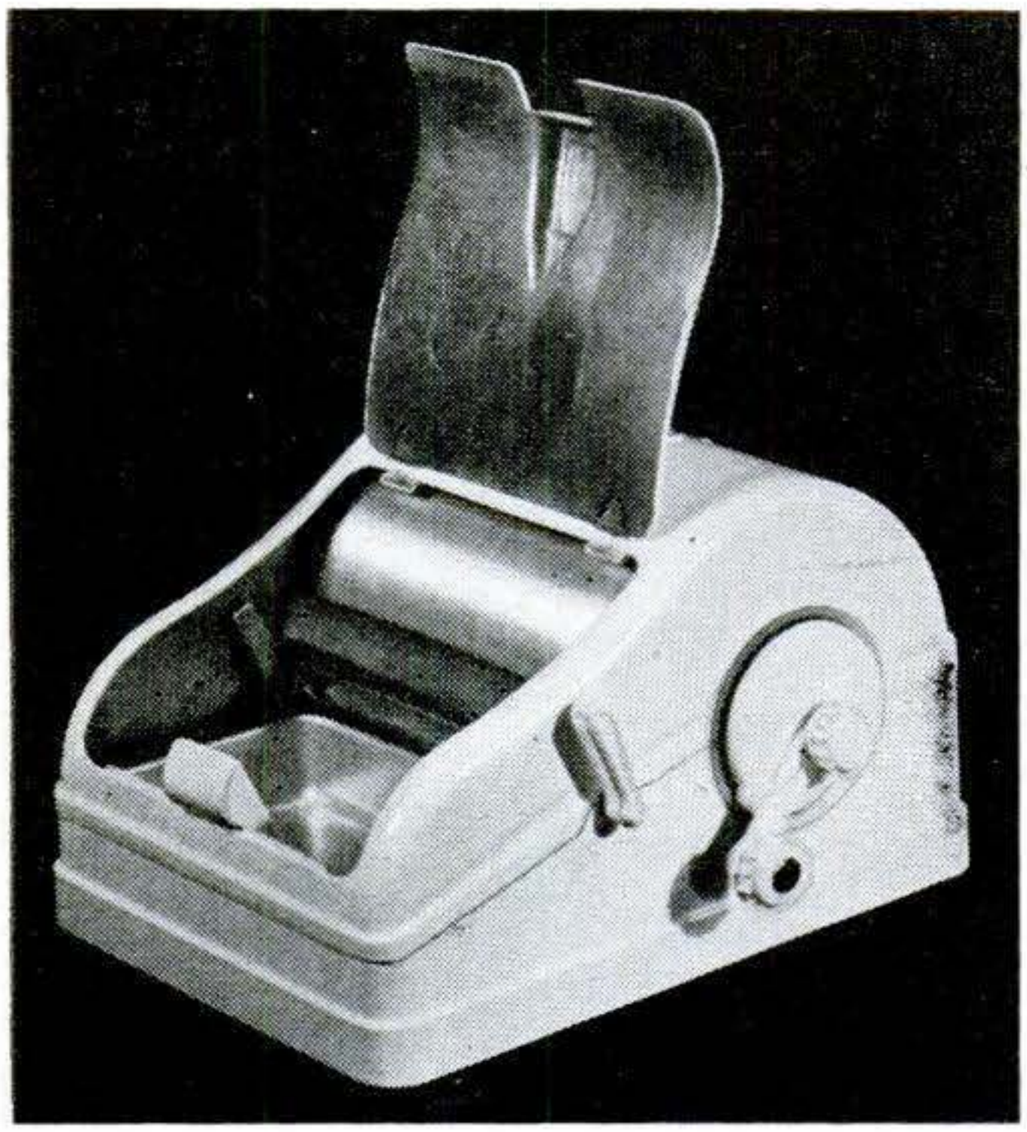
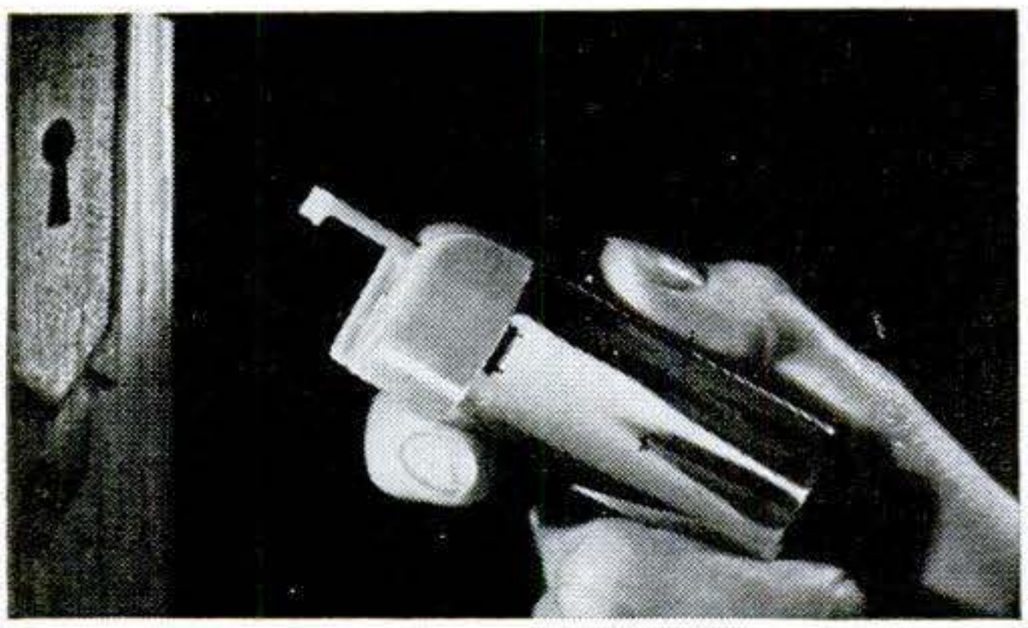
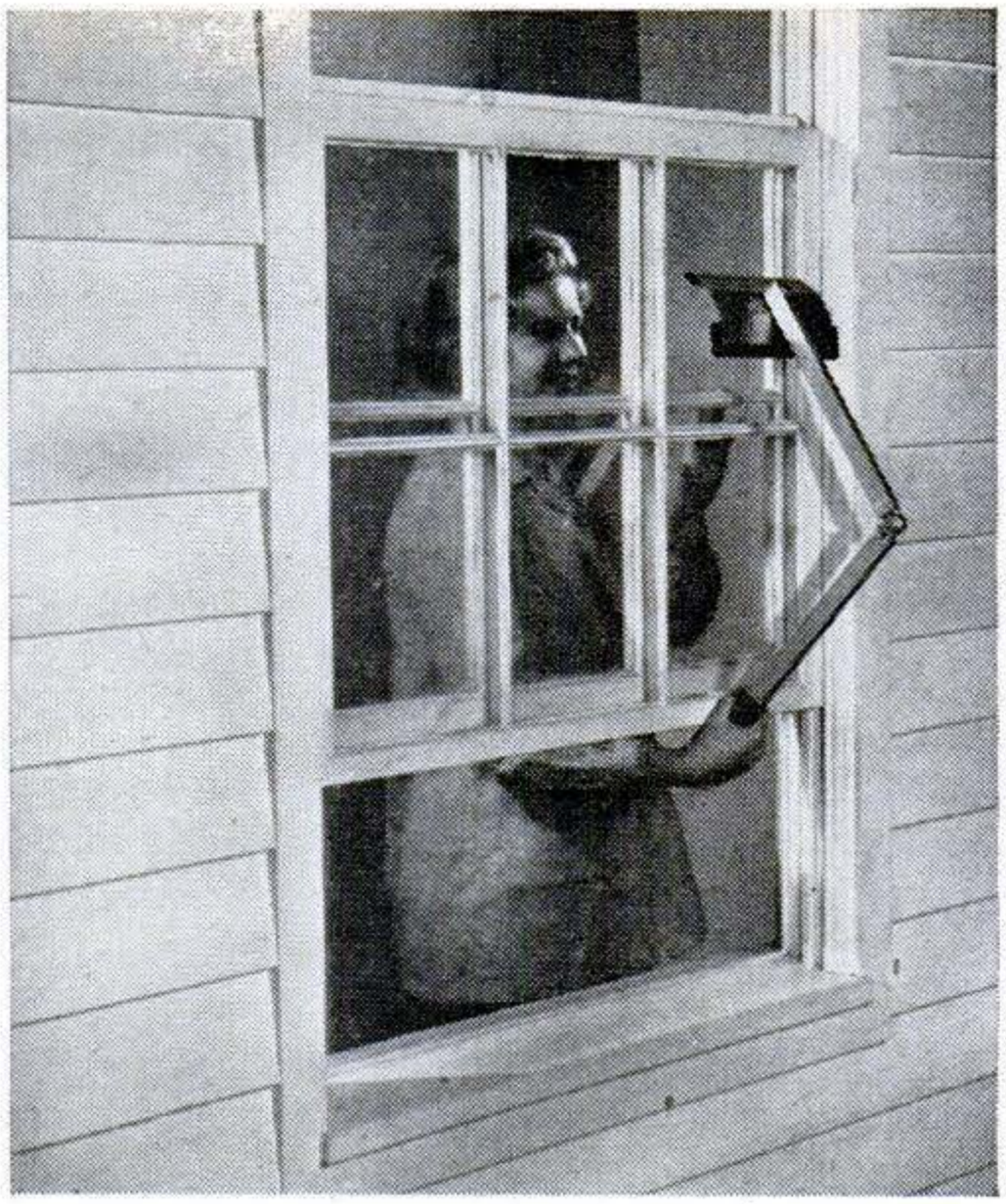
90-SECOND ICE CREAM. Frozen desserts of almost any description can be turned out in a minute and a half with the rapid freezer pictured below. Reversing the old process of circulating salted ice around the cream container, this freezer puts the ice in the middle to speed up the job. The enameled unit can be easily disassembled for cleaning. Each operation produces a pint of ice cream, automatically packed in an aluminum tray. One filling of ice and salt is good for a quart. About $20.

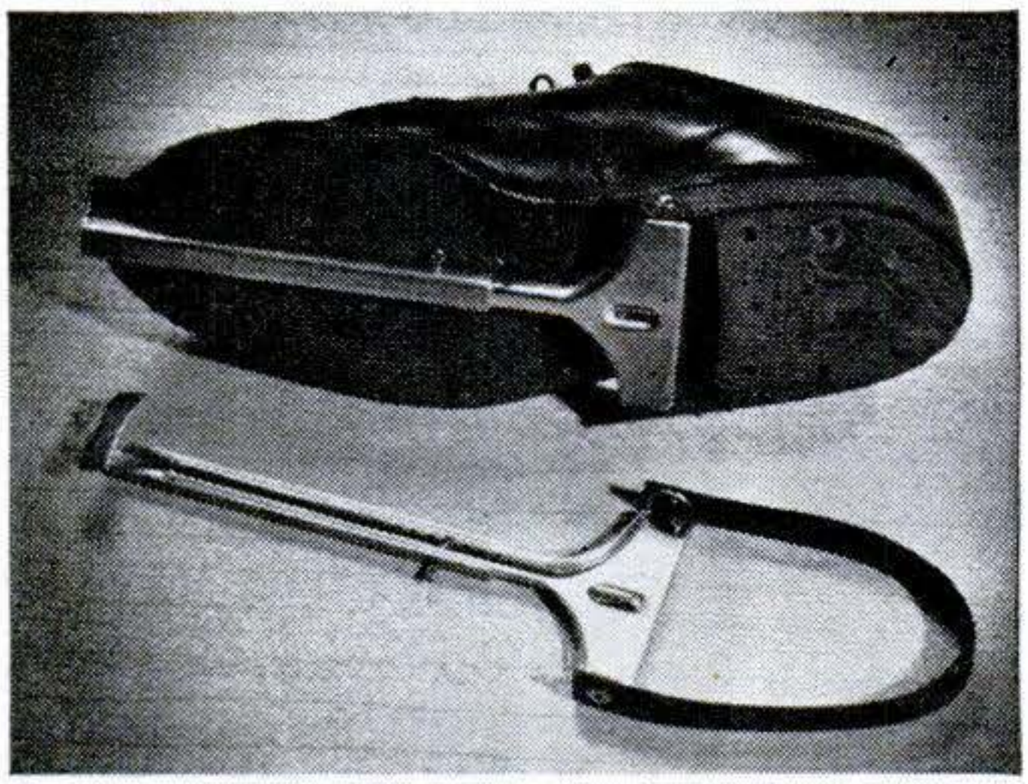


STREAMLINED POCKET LIGHT. Similar in appearance to a cigarette lighter, this metal and plastic flashlight flips open and on at the same time. Bantam-lite Inc. of New York makes the two-cell device in a variety of finishes, priced from $1.





INSIDE OUT. Cleaning the outside of windows is made safer and simpler by this light-weight magnesium arm that reaches out or bends in as needed. The arm itself is adjustable to any angle, and the washing head consists of a felt-tipped rim for applying the cleaning solution and a rubber squeegee for wiping it off. It is made by the Helen Pep Studios, of Kew Gardens, N.Y., and sells for about $4.



EXTERNAL SHOE TREES. Invented by a former G.I. to keep his footgear wrinkle-free, clean, and ready for inspection, this device keeps a shoe in shape by clamping on the outside. It is made of cold-rolled steel and web strapping, and is adjustable for most sizes of men's shoes. It is made by the Exeter Shoe-Tree Company, of Youngstown, Ohio, and retails for $1.50 a pair.

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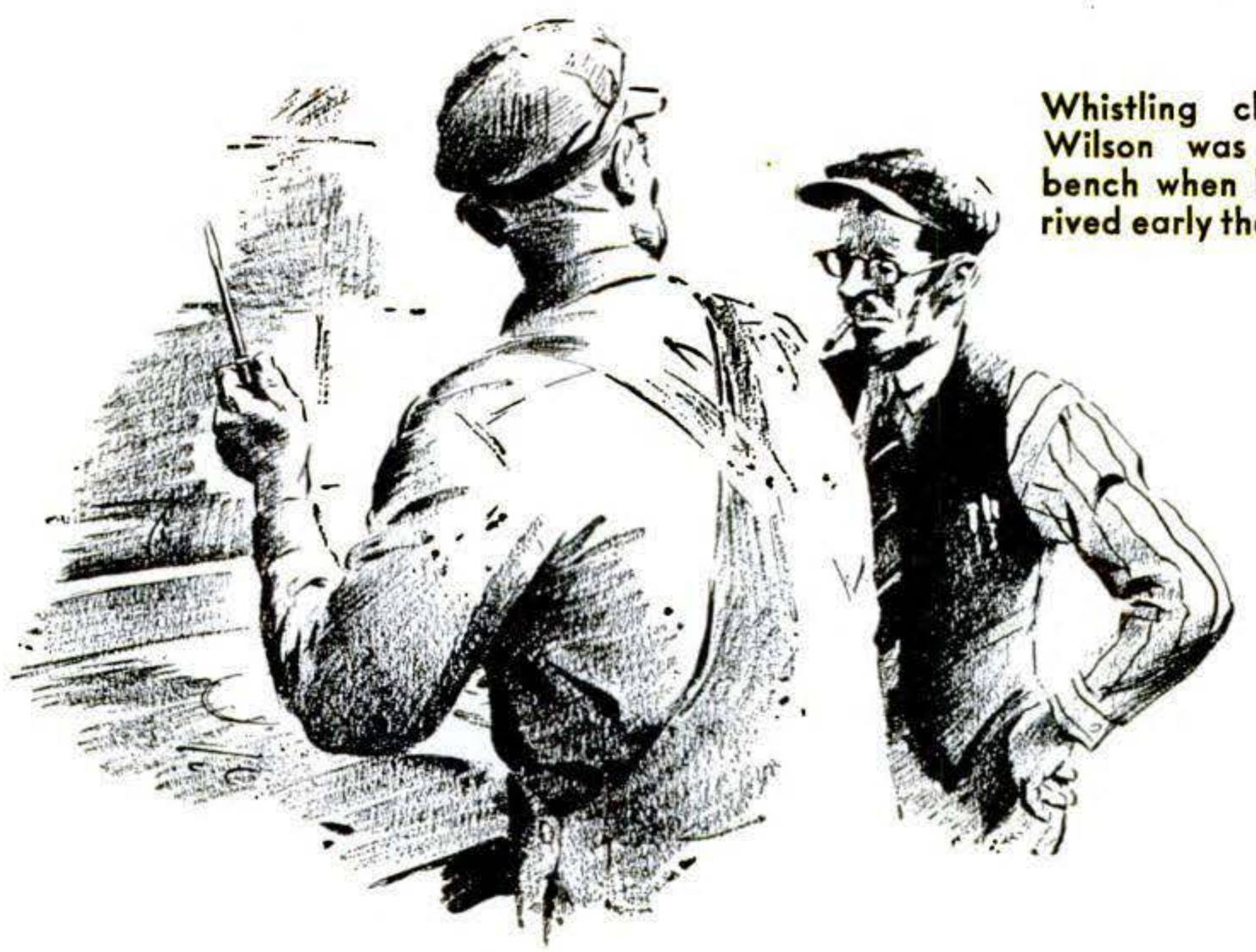

Whistling cheerfully, Gus Wilson was busy at the bench when his partner arrived early the next morning.

GUS Gives Special Service

By MARTIN BUNN

DR. MARVIN'S good-humored voice came over the wire. "A patient gave me tickets—nice seats . . ."

Gus Wilson laughed. "I'd enjoy going with you, Doc. Eight o'clock? Fine!" He put down the phone and turned to Joe Clark. "Doc Marvin wants me to—"

The telephone jingled again. Gus snapped an impatient "Hello" into the mouthpiece and listened. "All right," he finally yelled. "I'll be there in ten minutes. . . . Car gone dead up the highway," he fumed. "Almost closing time and I have a date with Doc."

It was just getting dark, the bleakest quarter hour of a late winter afternoon. Gus grouchily drove the wrecker up the highway and a little way out of town. As he topped a sharp rise in the road, he sighted a red sedan. A man whose head was scrooched into the fur collar of a long black overcoat motioned him to a stop.

"I'm Baermann," he shouted.

Gus nodded, continued a little way down the hill and off the pavement, and walked back. "What's the matter with your bus?"

Baermann withdrew a pair of pudgy hands from his pocket and made a helpless gesture. "You're asking *me?* I ain't no mechanic. We're driving along, and all of a sudden—glug—she stops. I'm in a hurry!"

"So am I," Gus grunted. He opened the driver's door. Two men were sitting in the back of the car. Even on the three-passenger seat, they were pressed together and their shoulders were wedged against the sides. One of them was so tall that his hat scraped the roof; his face was ornamented by a handlebar mustache. The other man, who was a full head shorter, held a battered and bulging briefcase on his knees with a pair of ham-sized hands. They stared silently.

Gus pressed the starter. The engine turned over but didn't take hold. He found the gas supply was low, but the tank wasn't empty. Unlatching the hood, he disconnected the line from the fuel pump to the carburetor, and pressed the starter relay. No gas pulsed out. "Trouble seems to be in the fuel line or pump," he said.

Evening traffic from the city began to fill the road. Hidden from sight in one direction by the top of the hill, the car was in a dangerous spot for extended parking.

"Can't work out here," Gus decided. "I'll back it down into that clearing."

Baermann was fidgeting nearby. "Okay, but I don't want my friends to catch cold sitting there. Wait a minute." He stuck his head in the door and mumbled something. The two passengers eased themselves out.

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"Pals," Baermann told Gus confidentially, his manner that of a fond parent. "But when they clash—" Instead of finishing, he rolled his eyes until only the whites showed.

Gus rolled the car to safety at the foot of the hill, got out, and again lifted the hood. "Get down by the gas tank," he instructed Baermann, "and listen." He detached the line to the fuel pump and blew into it.

"It's bubbling," Baermann yelled.

On a hunch, Gus replaced the fuel line and pressed the starter relay. The engine caught and began purring smoothly.

"It's fixed." Baermann scampered back.

"It's working, but I don't know why." The temperature had gone down with the sun, and Gus's hands were so cold he could hardly tighten the coupling nut. "I can't fix it here. Drive it to the garage."

Baermann looked at him slyly and seemed to be thinking. "Fine," he agreed.

"I'll turn around and you can follow me back." Gus started for the wrecker, noticing that the two huge passengers quickly resumed their places. Before he reached the wrecker the sedan's engine was whirring, and the car made a dark streak up the hill.

CUSTOMERS trying to beat him out of his fee usually made Gus mad, but tonight he felt almost amused by it. Now he'd be able to keep his appointment with Doc without rushing. He made a wide U turn in the wrecker and started back. Halfway up the hill he broke into a broad grin. The red sedan was stalled in the same spot as before, and Baermann stood alongside it, flagging him down frantically.

"Having trouble?" Gus paused alongside.

"It stopped again. You'll have to tow us."

"Oh, will I? After your trying to run out on me?"

Baermann plucked his cigar out of his mouth, his eyes popped open. "Run out on you? You told me to drive to the garage!"

Gus looked dubious. The fur-coated man could be telling the truth. Baermann clutched his arm, threw him a confidential, sidelong look, and nodded solemnly. "I'll take a chance," he said. "You've heard of the U. N.?"

"You mean United Nations?"

Pointing the mangled cigar end at the two men who were bulging out of the red sedan, Baermann murmured: "Ivan Poloutsoff and Pecci Benazet. You don't know them? Soon you will! In that briefcase, Benazet—but see how tight he holds it! And Poloutsoff never takes his eyes off it! If they agree—okay for One World! They go into secret session tonight. Mister, you *got* to help me get 'em there on time!"

"That's a pretty fishy story." Gus looked at Baermann suspiciously. "But I'll take a long chance on its being true." He hitched the wrecker's towline to the stalled sedan, and ten minutes later maneuvered the two machines into his shop.

WHEN the three riders had stepped out, Gus once more tried the starter. Again the motor caught and kept running.

"How about it?" Baermann peered over his shoulder impatiently.

From the gigantic pair came a rumble of talk. Benazet unbuckled the bulging briefcase. It slipped from his fingers, and its contents spilled over the floor. Gus caught a momentary glimpse of something vivid green and scarlet; then it was hidden by two huge bodies. When they straightened up, Benazet had the briefcase clamped under his arm, and Poloutsoff was stripping the paper off a brown parcel. He handed Benazet a sandwich and began to munch another.

"All day they worked and worked," Baermann whispered. "No time to eat, even."

Gus was far from convinced, but having gone this far he figured he might as well go all the way. The finger of doubt pointed straight at the fuel pump. Gus changed it.

"That's all I can do right now," he said.

Baermann hastily piled his friends into the car and jumped behind the wheel. "Thanks, mister," he shouted. "Maybe the world will owe you a lot!"

"Never mind what the world will owe me," Gus replied. "*You* owe me—let's see—"

"The U.N. will pay. Send the bill to the Treasurer General." The red sedan pulled away.

DR. MARVIN and Gus stumbled into their tenth-row seats at the Coliseum as the announcer started introducing the combatants in the wind-up bout. "In this kornar, wearin' green trunks, weighin' 291 pounds—Pecci Benazet, th' Basque Bomb! Wearin' red trunks, at 312 pounds, Ivan Poloutsoff, th' Roarin' Rooshin!"

"Obese types," Dr. Marvin observed professionally. "It would be interesting to examine them—"

"Examine me, Doc!" Gus groaned. "I'm a sucker!"

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The spectator in front turned around. "And how, brother! All of us rasslin' fans are suckers! Grudge match, they say! That double-crossin' crook Baermann got both them tramps workin' fer him. . . ."

Action fast and furious erupted under the lights. Poloutsoff, bellowing like an enraged bull, charged across the ring, seized Benazet around his ample middle, twirled him over his head a few times, then flung him to the mat and trampled over him with both feet. Benazet retaliated by sinking his gleaming teeth into the bulging calf muscles of Ivan's leg. He gnawed with seeming relish while the Roarin' Rooshin roared.

CLOSE by the ring, Baermann was waving his arms excitedly, apparently trying to shout some message to one or both of the struggling men. His bobbing arm stopped suddenly in midair, clamped in a traplike hand. Startled, the promoter turned.

"The Treasurer General wouldn't pay up," Gus said.

"Huh?" Baermann's face paled. "Oh—I was just kidding, mister. Anything for a laugh. . . . How much?"

WHISTLING cheerily, Gus was busy at the bench when his partner came in next morning.

"Make the bouts last night?" Joe asked.

"Yup. Almost missed 'em though." Gus indicated the fuel pump lying at his elbow.

Idly, Joe picked it up, reached under the housing, and pressed the rocker arm. Holding a finger over the outlet port, he heard and felt the air push by. "Seems all right to me," he said.

"Not bad," Gus admitted, "but you can't tell with pumps. Even when the diaphragm is cracked, you can often feel the pumping action. If you put that in another car it might run for weeks."

"Then what made it give out last night?"

"As near as I can figure, a combination of things. The motor starved out on a hill when it needed extra gas the pump didn't give."

"Doesn't it usually provide more gas than is used?"

"Yes, but the slope of the hill put the gas tank several inches below where it normally is in relation to the pump. That meant that still more suction was needed. Then a couple of heavyweights depressed the back of the car another four inches or so. What with the low level of gas in the tank, it all added up."

"Guess it did." Joe turned back toward the office. "Got the slip on the job?"

Gus grinned and handed his partner the shop slip and twenty-five dollars in bills.

"What?" yelled Joe. "Twenty-five bucks for that job?"

"Nope," said Gus, "six bucks for the job and nineteen for special collection service."

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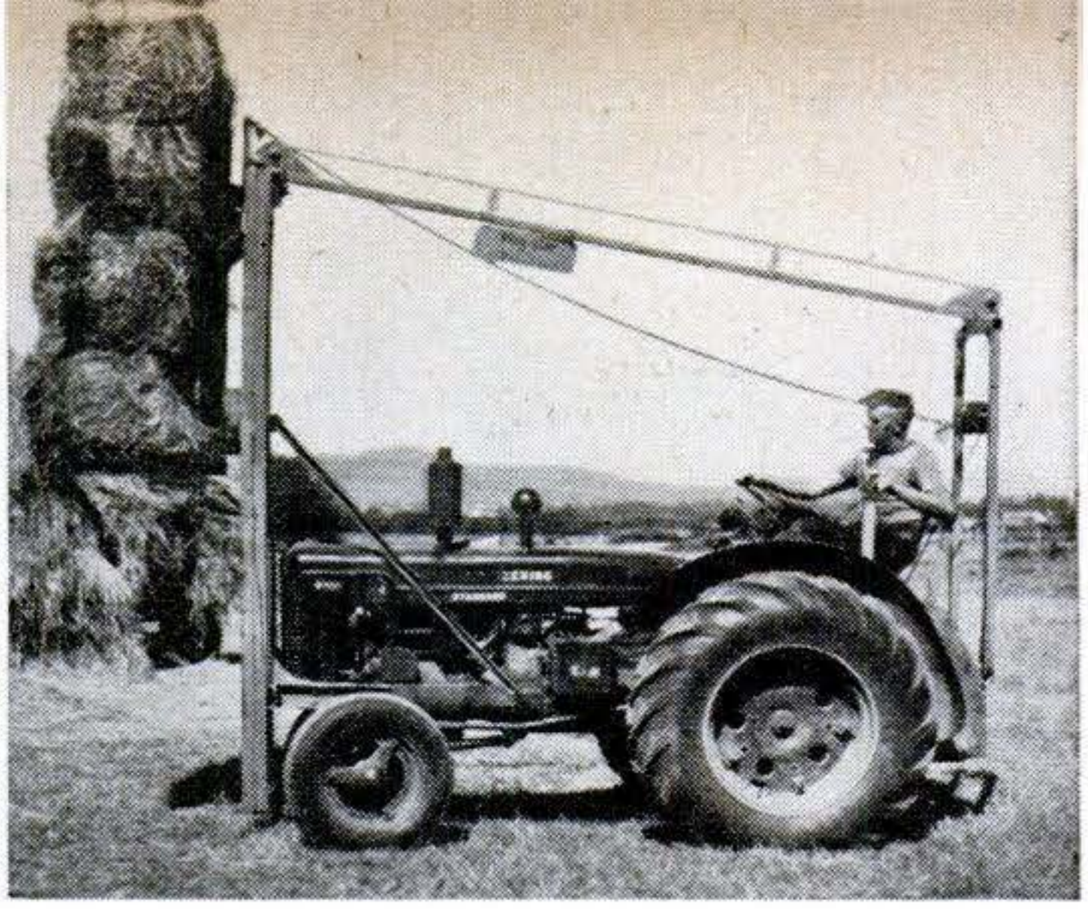
With the sweep rake at bottom position, the tractor is driven forward to scoop up a hay cock. Raised from the ground, the hay then is carried to stack or baler.

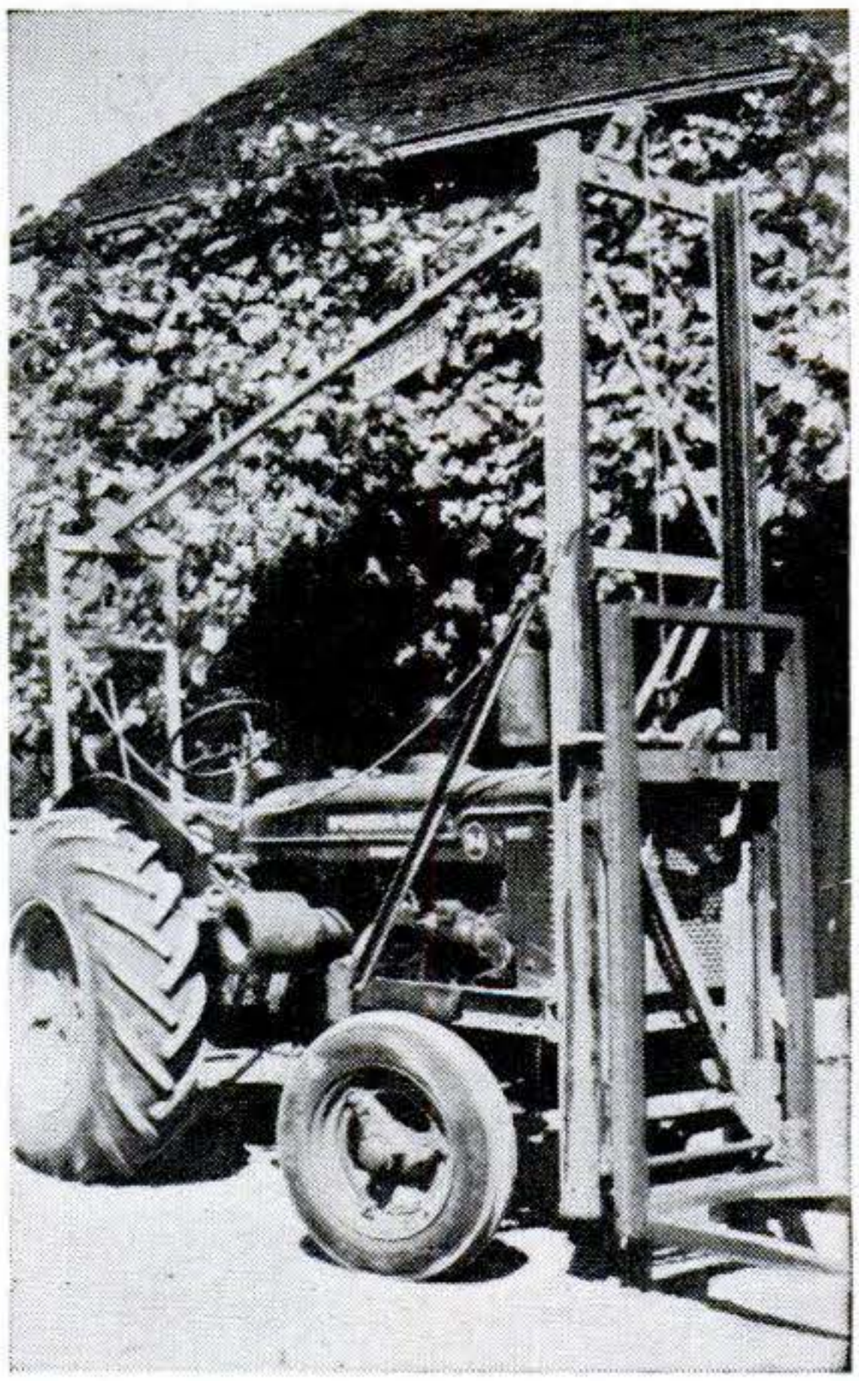


After the hay is baled, tractor power raises the heavy bales to the proper height for easy loading on the truck or wagon, as shown above.

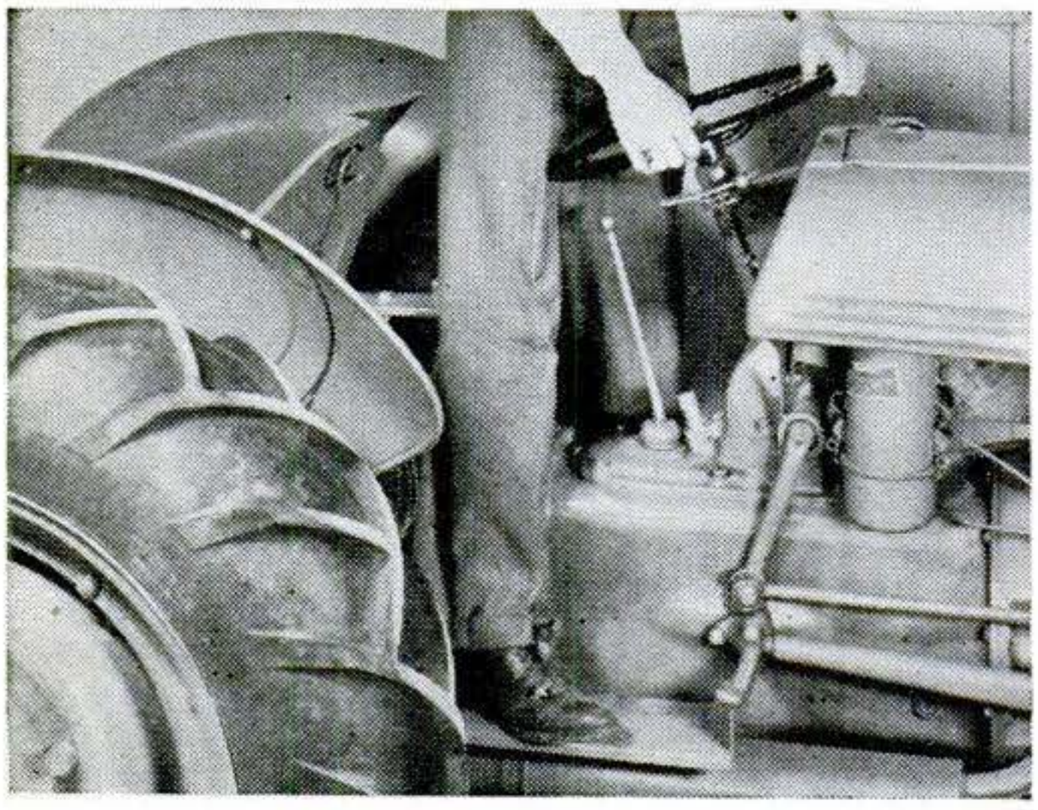
Tractor Power Operates Combination Rake and Loader on Canadian Farm

BELIEVING in getting full value from a tractor, James M. Amos and V. S. Polson have rigged up a combination sweep rake and bale loader that speeds up haying operations to a marked extent on their farm in British Columbia. With the rig, they have handled as much as 30 tons of cocked hay and 60 of baled hay in a day.

Only two minutes are required to detach the rake and put the bale loader on in its place. As can be seen in the accompanying photos, the rig consists of a framework mounted fore and aft on the tractor and held rigid by an overhead brace. The latter serves as a guide for a cable run through pulleys from a winch in the back to an elevating platform in front. By means of the winch, which has a 12-to-1 reduction from the tractor power takeoff, the operator can raise or lower the elevating platform at will.



An elevating platform tracks on upright rails at the front of the tractor, the operator raising or lowering it by means of the tractor-driven winch.



Standing Position on Tractor Reduces Operator Fatigue

ALLOWING the operator to assume a standing position if desired while driving a tractor, a hinged seat assembly and steps for the right and left side of the machine are offered by Harry Ferguson, Inc., of Detroit, producer of mechanized farm equipment. The steps are treated with a nonskid material. The manufacturer reports it has been found that the operator becomes less tired if he can change position occasionally during long hours of driving a tractor.

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MONOXIDE Thumbs a Ride

Drowsy while driving? Make sure carbon monoxide isn't poisoning you at the wheel. A checkup may save a life.

CARBON monoxide is a hitchhiker. We all know that this odorless gas, generated by an automobile at the rate of about a cubic foot a minute, will quickly turn a closed garage into a death chamber, but we are apt to overlook the fact that it rides along each time we drive out on the highway.

Its handiwork shows up in traffic accident news more frequently than most persons realize. The police reports may say that the driver "apparently fell asleep," or perhaps a big question mark appears in the space where the cause of the accident should be recorded, since no one remains alive to tell about it. Some of these accidents, it is true, result from lack of sleep or just plain weariness after long hours of driving, but there seems to be no doubt that a good percentage occur when carbon monoxide, stealing a ride in the car, dulls the senses of the driver.

As an agent of death, carbon monoxide works by combining with the red corpuscles, preventing the blood from carrying oxygen throughout your body. A little goes a long way. Just two parts in 10,000 of air are enough to impair perceptions; and not much higher concentrations, breathed for a sufficient time, can prove fatal. When a car engine is operated in a closed garage, the air becomes dangerous to breathe within three minutes. Safety education has made most people aware of this, but comparatively few realize that there are equally important precautions that should be taken to minimize the danger of carbon monoxide out on the highway.

Tests conducted in Connecticut by the State Health Department and the Travelers Insurance Company underline the need for such precautions. Traces of carbon monoxide were found in nearly 50 per cent of a

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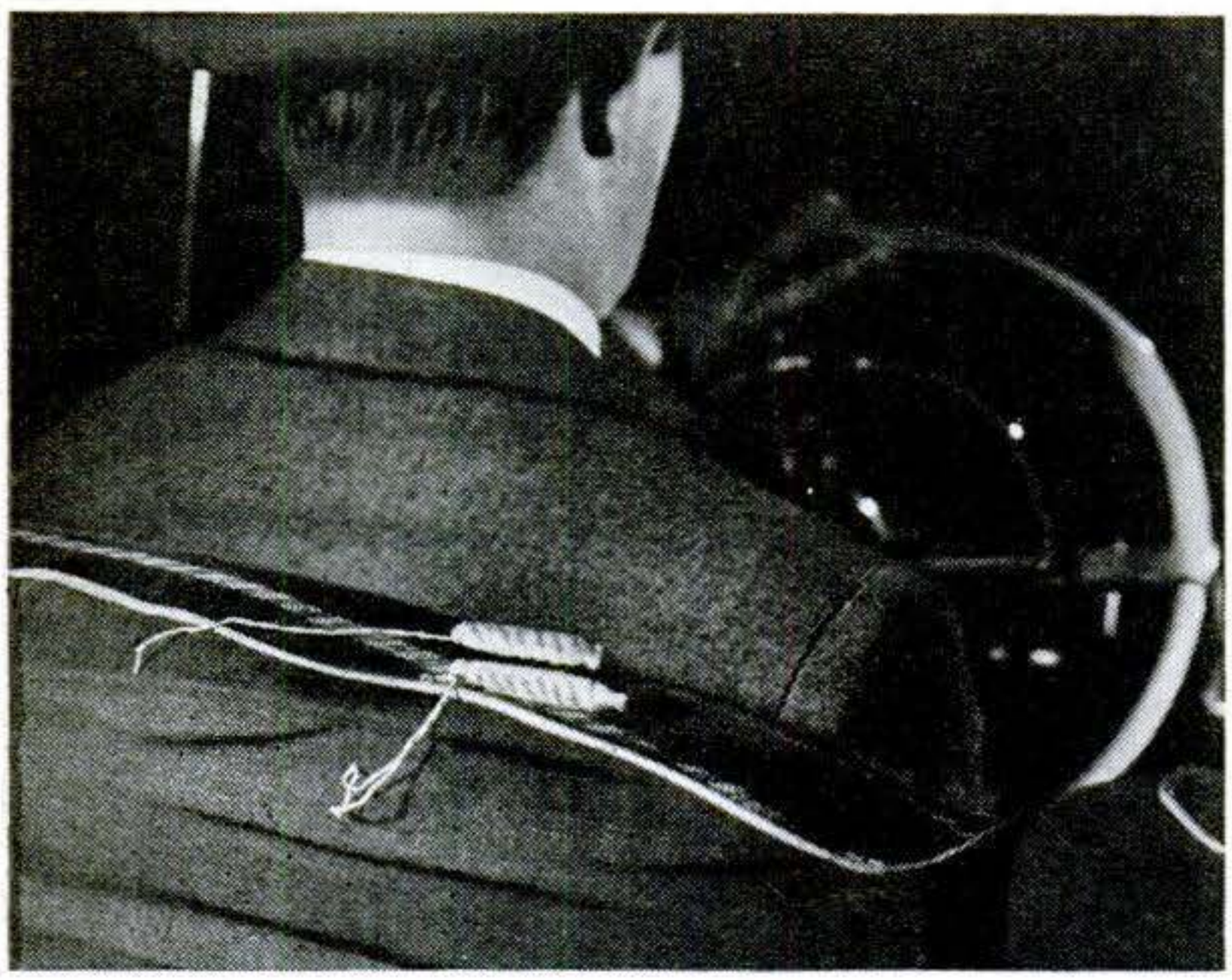
group of cars checked at random along the highway, and in more than 10 percent there were dangerous concentrations—enough to dull the senses, and possibly produce unconsciousness.

Concentrations of carbon monoxide below about 3.5 parts in 10,000 are not immediately dangerous, but if you are exposed long enough this amount will produce headache, mental dullness, and a sense of physical weariness. At 2 parts in 10,000, these primary symptoms generally occur in about two hours. Such symptoms, usually disregarded, are often the cause of inefficient driving and accidents.

Hence, if you ever develop a feeling of unreality while driving and the traffic and city street or countryside seem like something seen in a dream, it is high time that you open the car windows wide and pull up and park immediately until you again feel normal. Also, be wary of a headache that develops while you are driving.

If you suspect that an unsafe percentage of carbon monoxide is contaminating the interior of your car, you can make a test with the detector ampoules manufactured by the Mine Safety Appliances Company, of Pittsburgh. Although devised for the detection of dangerous carbon monoxide concentrations in manhole entrances, the ampoules are now used by garages, chemical plants, and other industries for the same purpose. They cost $1.25 for 10 ampoules.



Small chemical detectors made by the Mine Safety Appliances Company provide a way of testing a car for carbon monoxide.

If monoxide is present, the detector will change color, the final color depending on the gas concentration. Comparing the exposed detector with a chart shows the concentration.

Smaller than a cigarette, one of these ampoules will detect the presence of monoxide in air in concentrations as low as 2 or 3 parts in 10,000. They consist essentially of palladium chloride in an acetone-water (nonfreezing) solution, sealed in a glass tube surrounded by cotton.

In use, the ampoule is crushed between the fingers, allowing the solution to saturate the cotton. The ampoule is then left for 10 minutes in a place where carbon monoxide is suspected. Originally, the crushed ampoule is yellow. If monoxide is present, metallic palladium will darken the cotton, the depth of discoloration (running from a light gray to a grayish black) depending on the concentration of the gas. The concentration then can be determined by comparing the color of the ampoule after 10 minutes with the scale of colors on a chart furnished with the set. In a car you might place the crushed ampoule on top of the front seat, or better still, hang it by a cord from the roof.

Contamination of the interior of a moving car may result either from the exhaust gases of your own car or those close ahead. A leaking exhaust system or a rusty or battered muffler often will allow the deadly gas to seep through cracks in the floor or doors. In some cars exhaust gases, instead of flowing away to the rear, actually move along with it because

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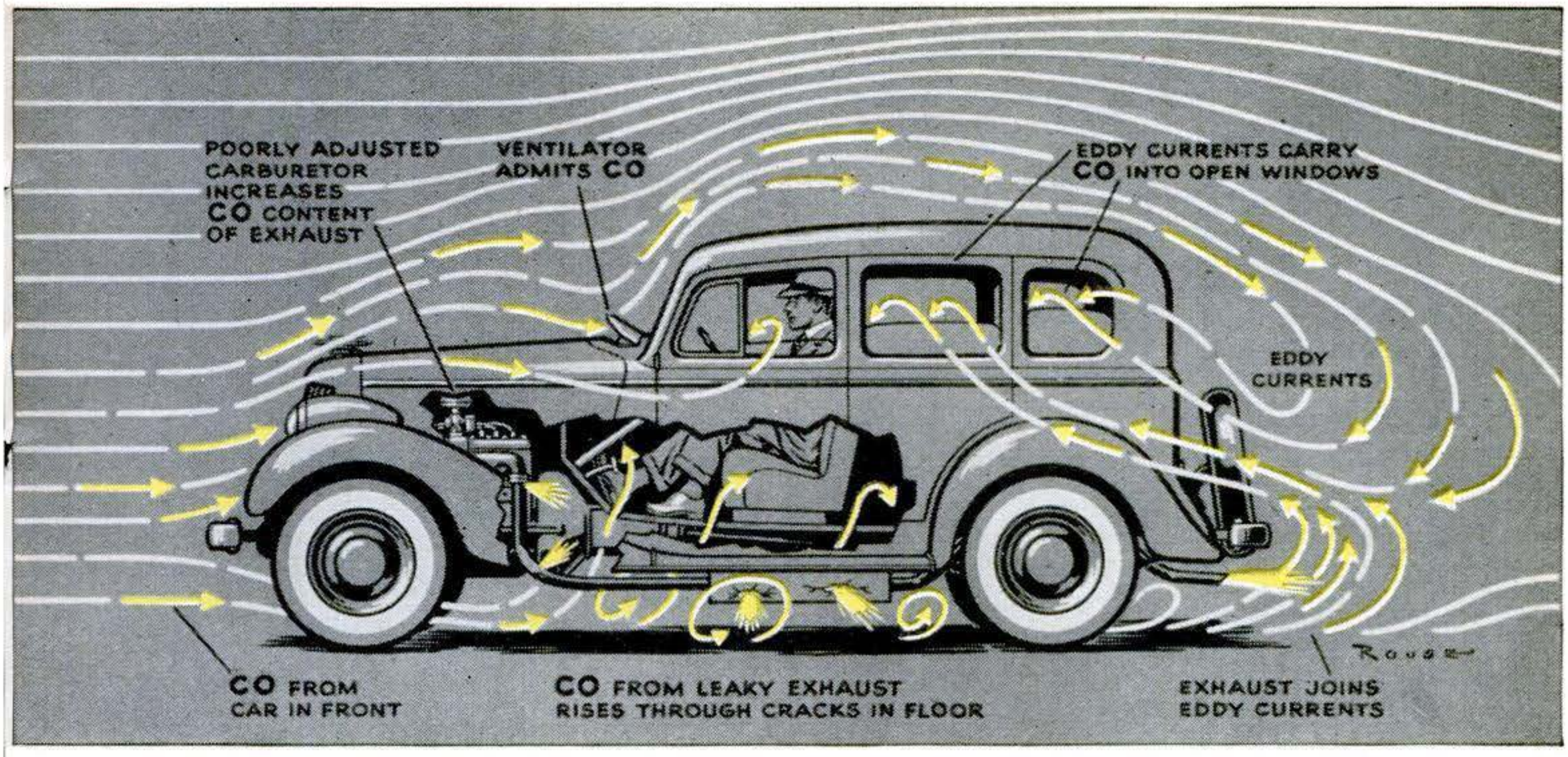


Monoxide, from the car in front as well as from your own, can enter by many routes, including open windows.

of the turbulent flow of air immediately behind, and monoxide-laden eddy currents may whip into the open windows—looking for a victim. If all of these sources of contamination joined forces, as easily they might, the car could soon become a rolling death trap.

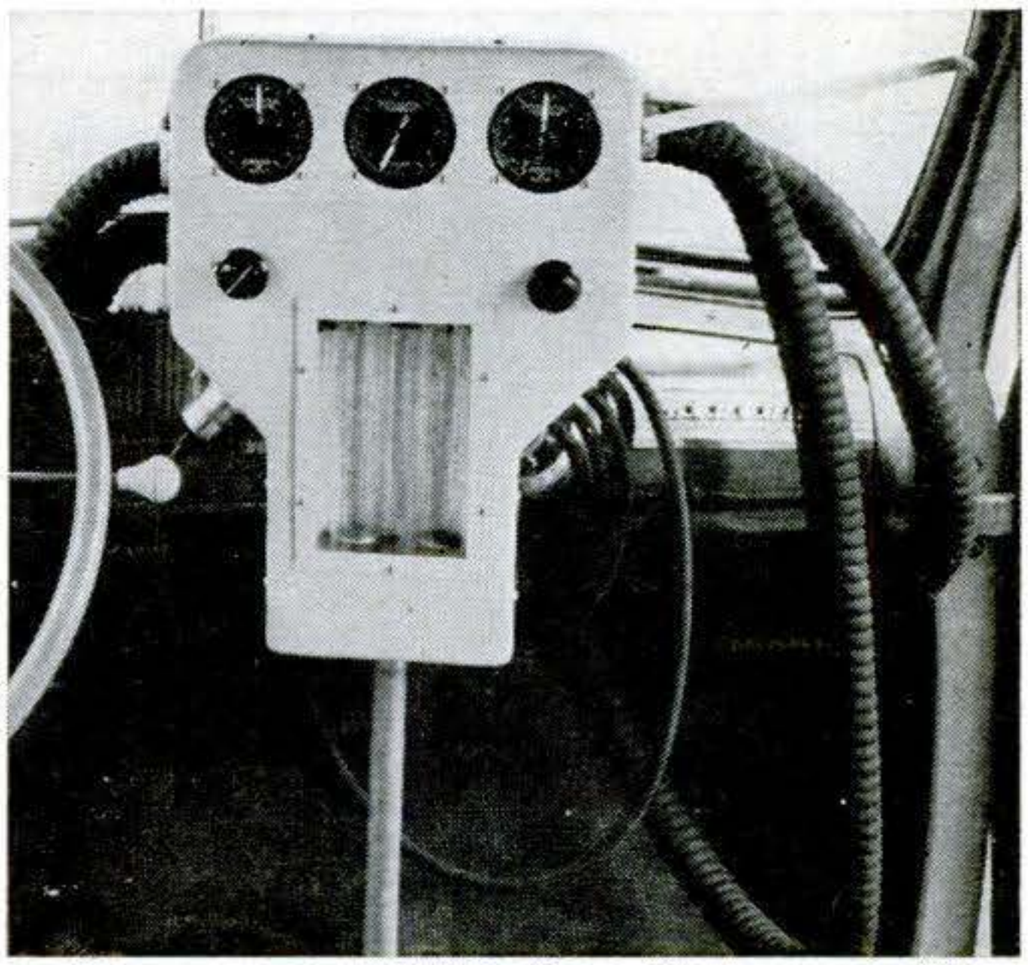
Since carbon monoxide is a product of poor combustion, proper adjustment of the engine is an important factor in reducing the hazard. Experiments by the U. S. Bureau of Mines have shown that the proportion of this gas in automobile exhausts ranges from 1 to 13.72 percent and that the amounts vary widely at high and low speeds and with good and poor carburetion. As combustion efficiency increases, the monoxide content of the exhaust naturally decreases. The percentage may be as high as 13 from a poorly adjusted motor running at 50 percent efficiency. When the car has been tuned up to run at 80 percent efficiency, the monoxide content drops to 4 percent.

These percentages sometimes are put to use in reverse. Some garages have equipment to determine the monoxide content of a car exhaust. From this, it is possible to estimate the efficiency of the engine.

Flow Meter Developed by Ford Tests Crankcase Ventilation

DESIGNED for use in a test car under actual operating conditions, the flow meter shown in this photo was developed by the Ford Motor Company as a means of measuring the efficiency of various systems of crankcase ventilation. Such ventilation, which involves an induced flow of fresh air through the crankcase to carry away blow-by gases escaping past the piston rings, has been the subject of considerable research and study.

Instantaneous readings may be taken from the Ford meter, which is two duplicate instruments built as one and attached to the normal engine ventilating system. One measures the flow of fresh air entering the engine, the other the outlet flow.



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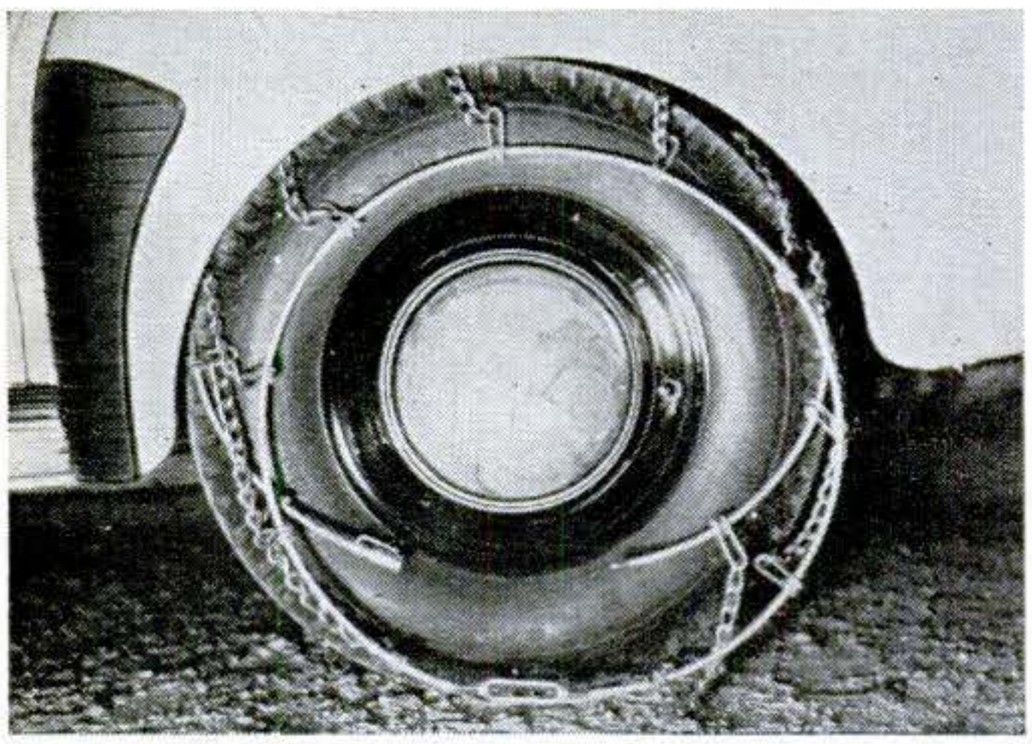
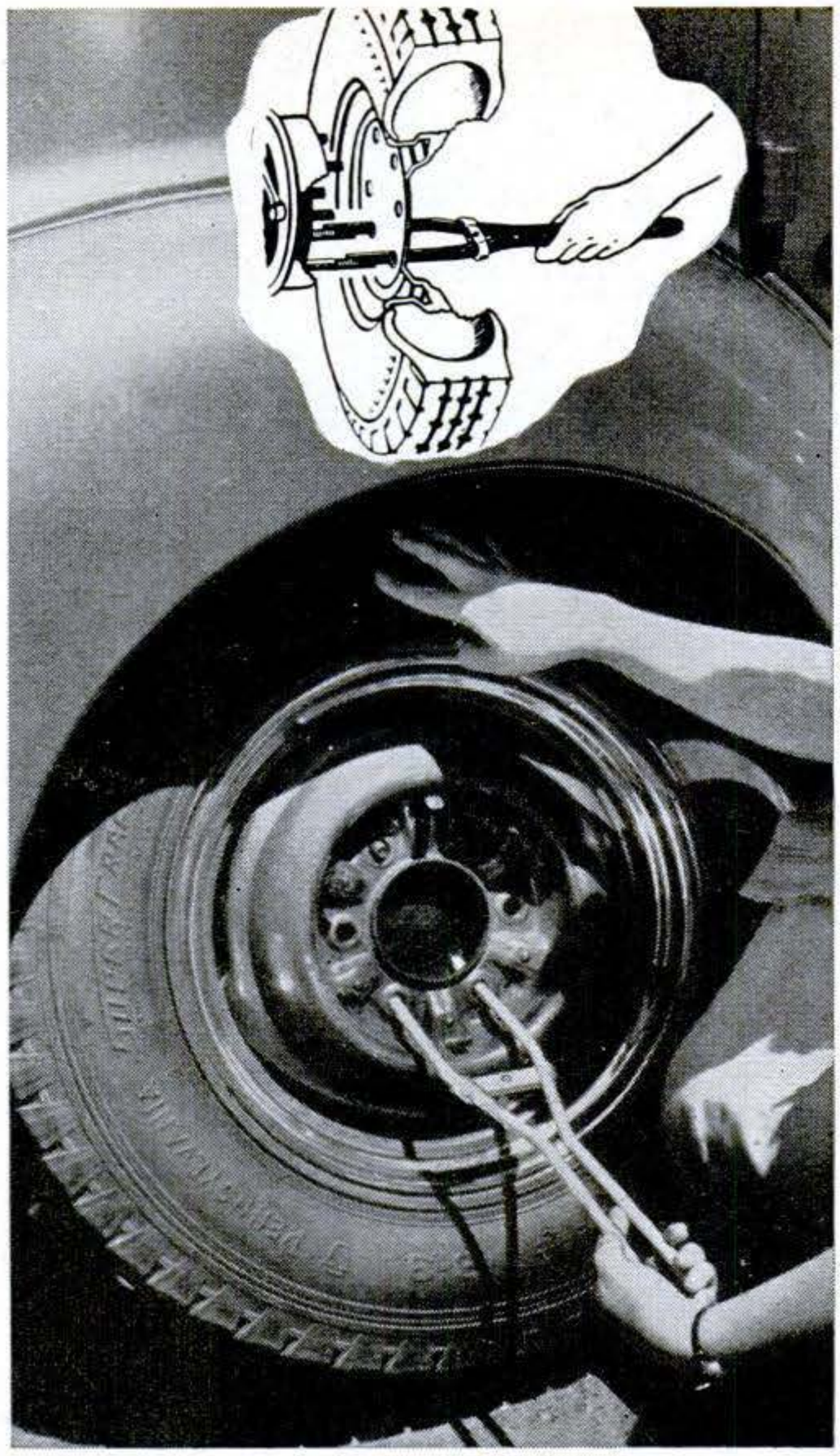
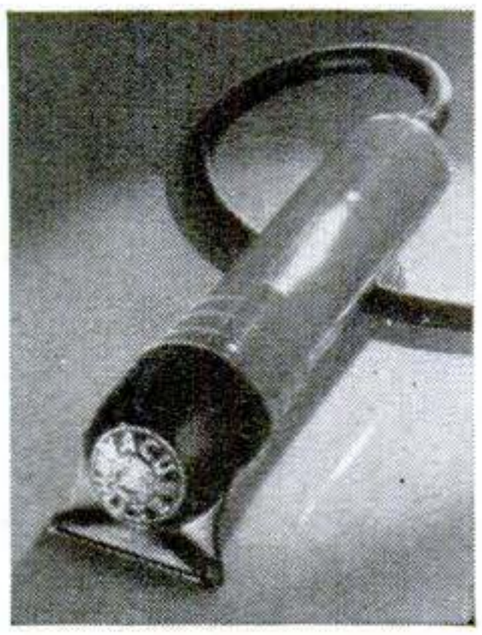
AUTO IDEAS

SKID CHAIN. A tire chain that can be put on without jacking or rotating the wheel has been invented by C. H. Reynolds, of Donora, Pa. Two flexible rings hold the links across the tire, and lock in place semiautomatically. Early production is planned.





CAR CLEANER. This miniature vacuum cleaner operates off the intake manifold. It is made by Craft Industries, Inc., of Buffalo, and retails for about $5 with all accessories needed for quick and easy installation.



TIRE-LIFTING TOOL. Changing wheels will be easier with this two-pronged device that simultaneously supplies lifting leverage and lines up the wheel holes with the proper bolts or lugs. Prong spacing can be adjusted to suit any automobile wheel. The T. E. D. Corporation, of Los Angeles, is the manufacturer of the new wheel changer.

TROUBLE LIGHTS. Bright illumination for use in and around a car is obtained with lamps that can be plugged into cigar-lighter sockets. Two such devices are shown here, and similar ones have been announced by other manufacturers. Different mounting and reflector features include a magnetic clamp and a case that opens into a stand.

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MECHANICS AND HANDICRAFT

- Making Plastic Bathroom Fittings
- Steam-Driven Toy Auto
- Modelmaker's Paint Sprayer
- Abrasives as Shop Tools
- Photographic Black Magic

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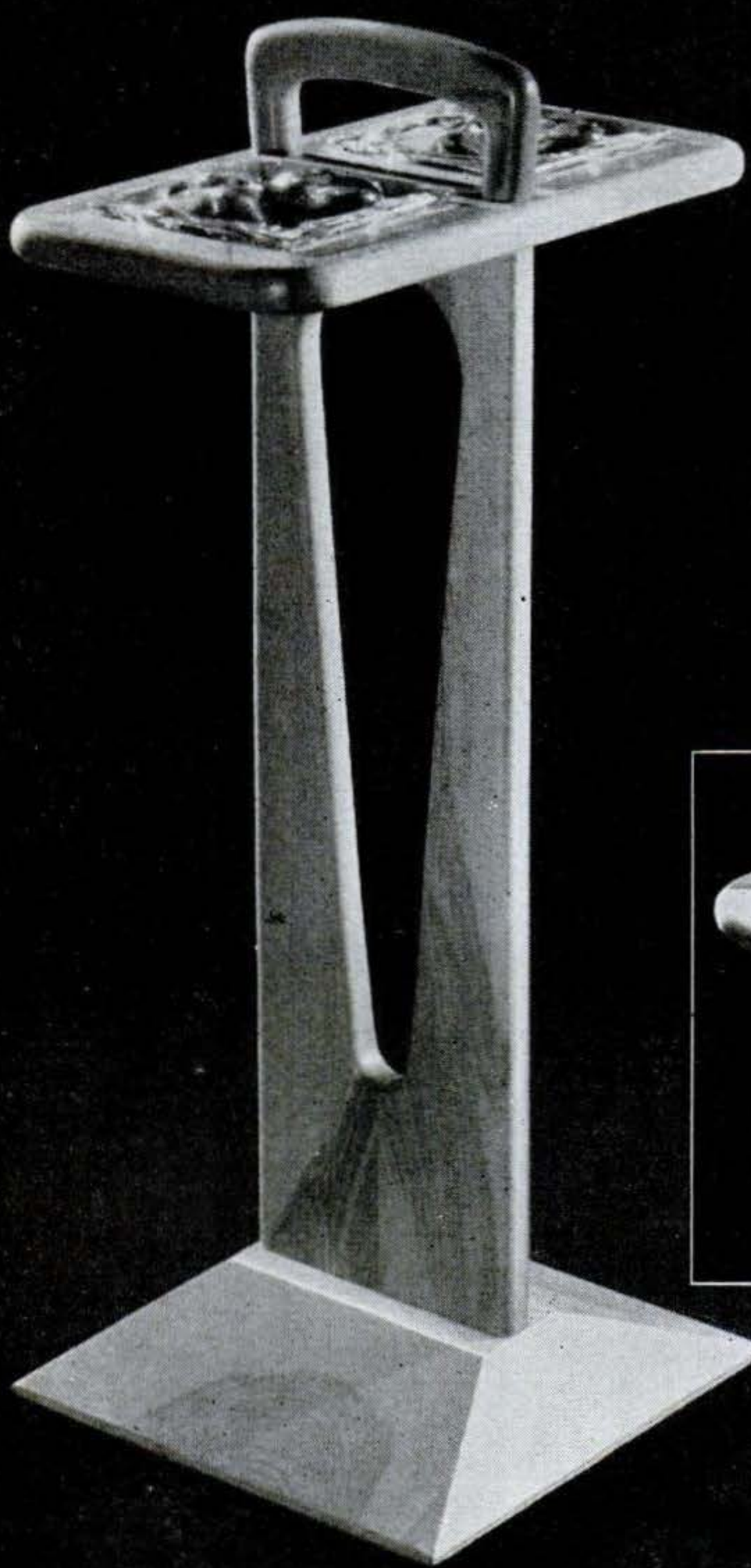
Modern
SMOKING STAND

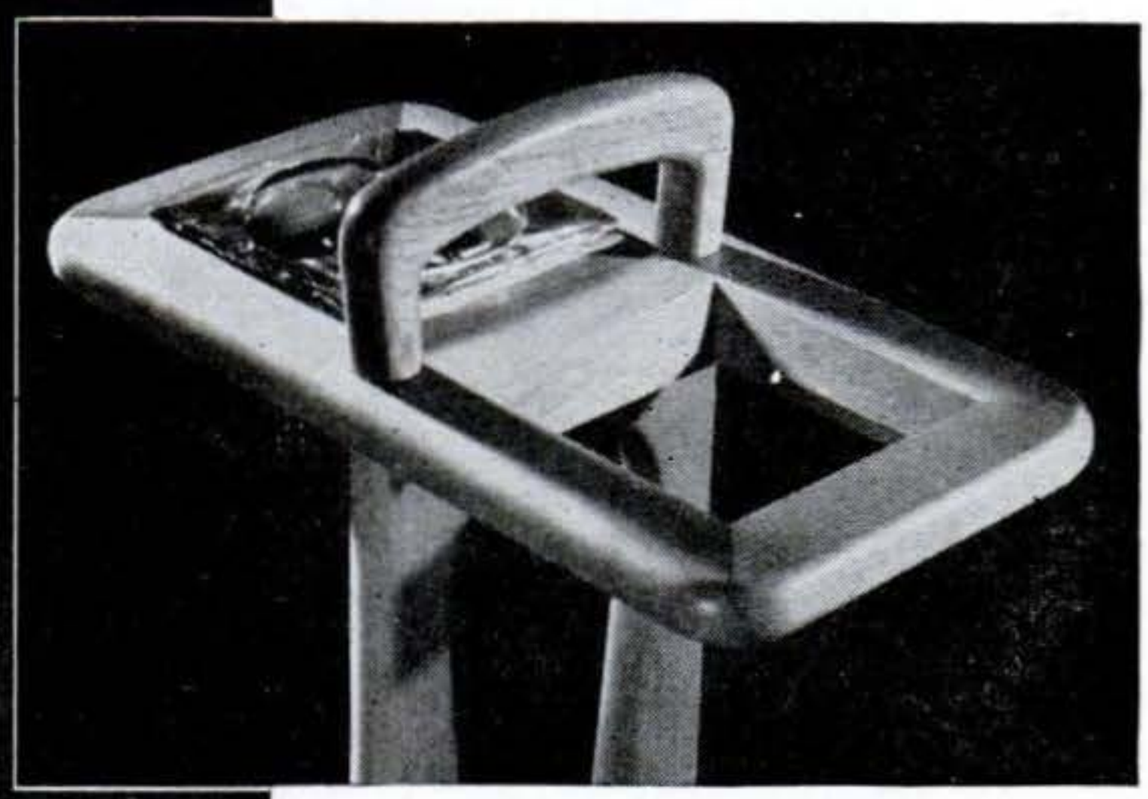
By JOSEPH ARONSON



LIGHT-COLORED wood such as birch or maple, finished with clear varnish, complements the modern style of this smoking stand. Select the wood carefully so the grain will show for the best effect.

The table part holding two glass ash trays is made as a frame with mitered and doweled corners. One way to get the beveled inside edges is to cut them on the frame members before assembling, but care must be taken in fitting the middle crosspiece. The frame can instead be built of narrow stock, without the bevel, and mitered bevel molding then glued in. Be sure to obtain the ash trays before starting work so that you can alter the frame dimensions if necessary to fit the trays.

Cut the handle from one piece with the grain running horizontally. For the handle shown, stock was chosen with knots spaced so they came at the bends, and the whorls carried the grain there at right angles. This is hardly neces-



Two square glass ash trays, set in the open frame and supported on a beveled molding, can be taken out readily for emptying and cleaning. Metal trays can, of course, be used instead. A handle is doweled into the upright piece through the frame. All edges are sanded round.

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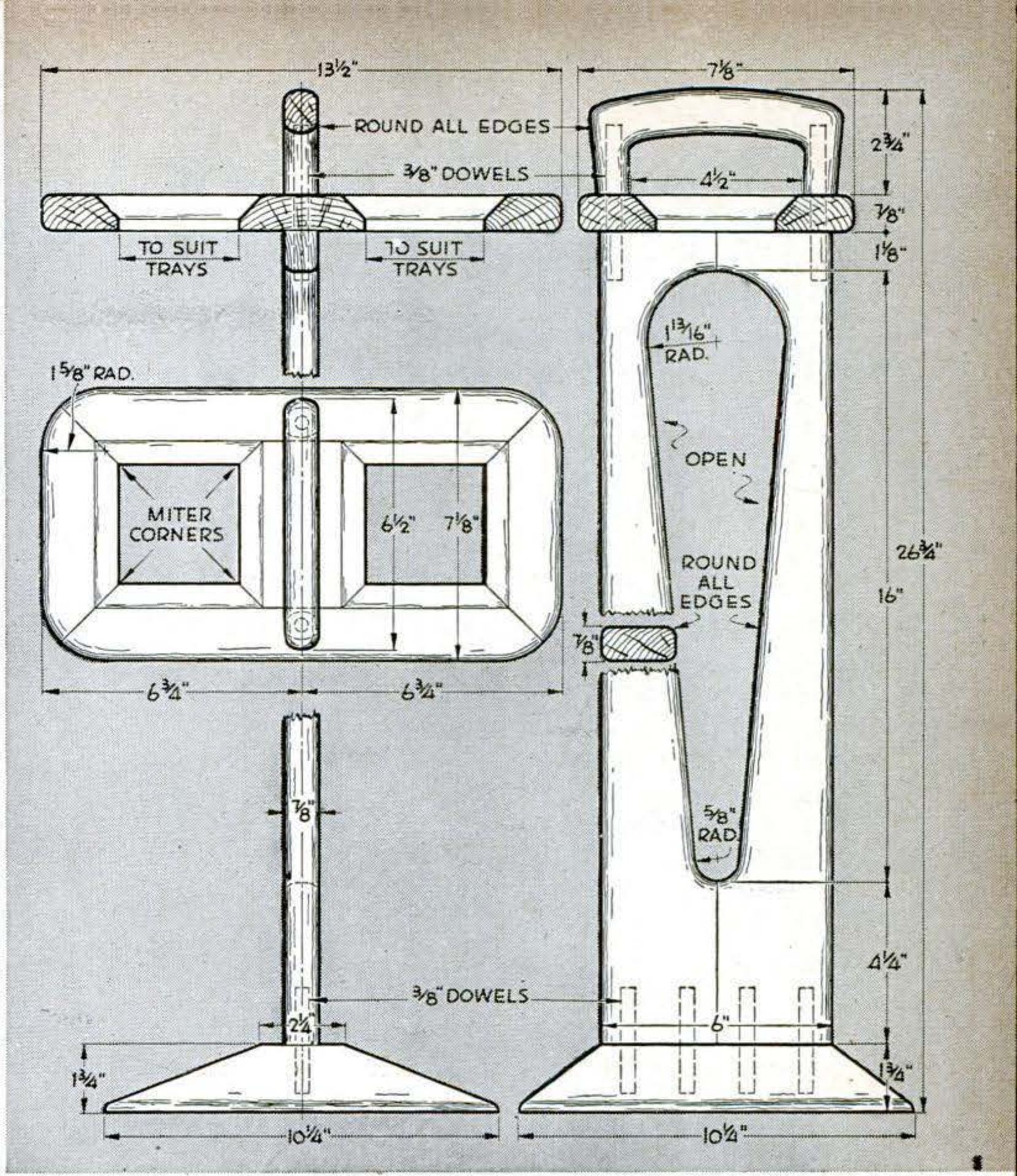
sary for strength, which is provided by the dowels in the joints.

The upright is most easily made of two mating pieces, bandsawed to shape, jointed, and glued. If you don't mind a little work with the jigsaw, it could be made from one board with the center section sawed out.

A good-sized bandsaw affords the quickest way of beveling the sides of the base, although careful work with a handsaw and plane will also serve. Note that the bevels are at two different angles, one for each set of opposite faces. The base is doweled and glued to the upright. Four dome gliders are put on the bottom.

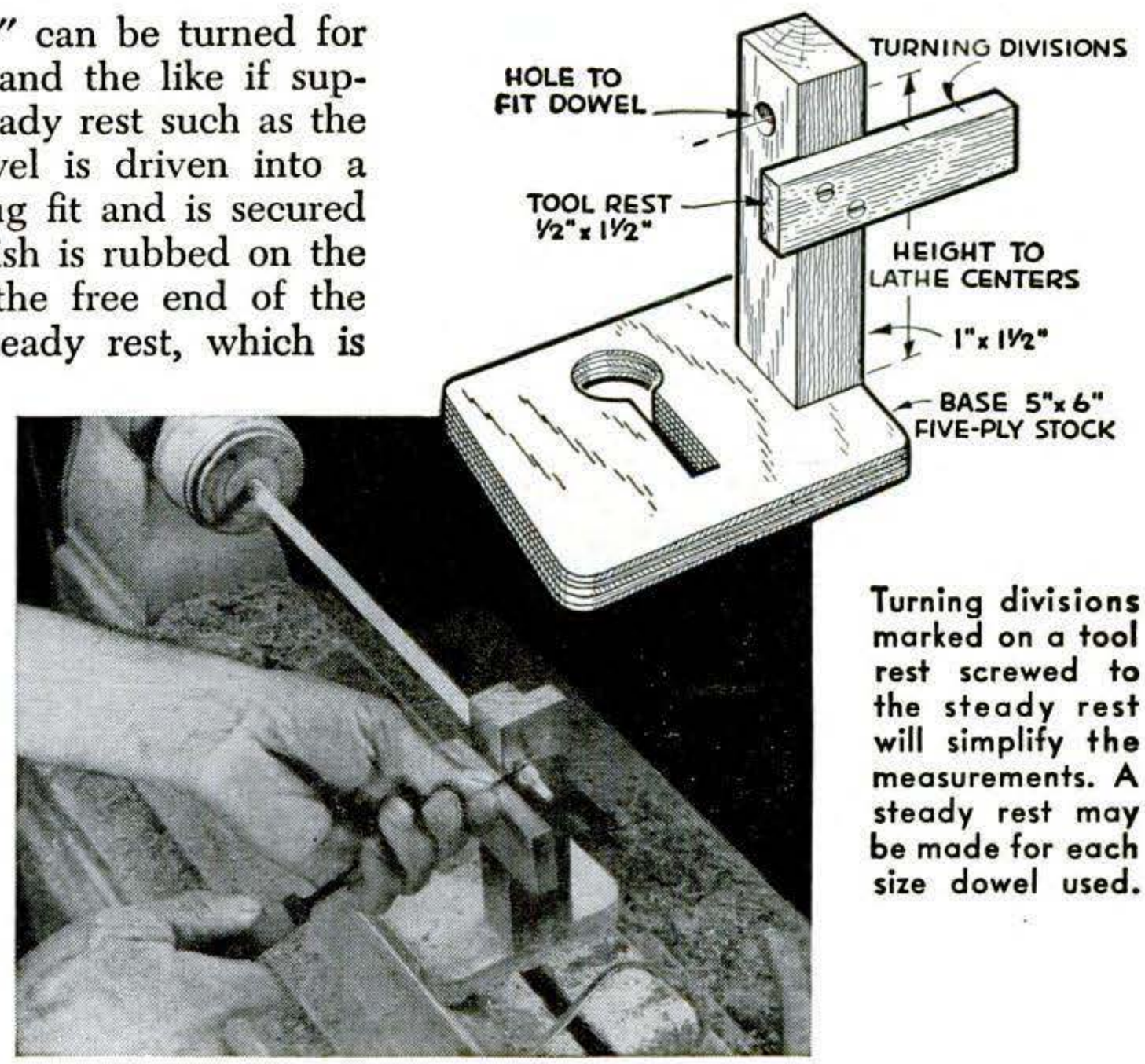
A natural finish can be obtained with a penetrating sealer and wax, with clear varnish and wax, or with wax alone.



Wooden Steady Rest Supports Dowel Stock for Small Turnings

Dowel lengths up to 18" can be turned for chessmen, pegs, toy parts, and the like if supported in the lathe by a steady rest such as the one shown here. The dowel is driven into a wooden chuck drilled a snug fit and is secured with a brad. Furniture polish is rubbed on the stock for lubrication, and the free end of the dowel is inserted in the steady rest, which is clamped on the lathe ways with enough of the dowel stock projecting from it for turning one complete piece.

Run the lathe at next to highest speed, and cut off the piece with a skew chisel when it is finished, encircling and catching it with the left hand. The steady rest can then be unclamped and moved to the next working position on the ways without stopping the lathe.



Turning divisions marked on a tool rest screwed to the steady rest will simplify the measurements. A steady rest may be made for each size dowel used.

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for DAD to build

BUNNY CRADLE

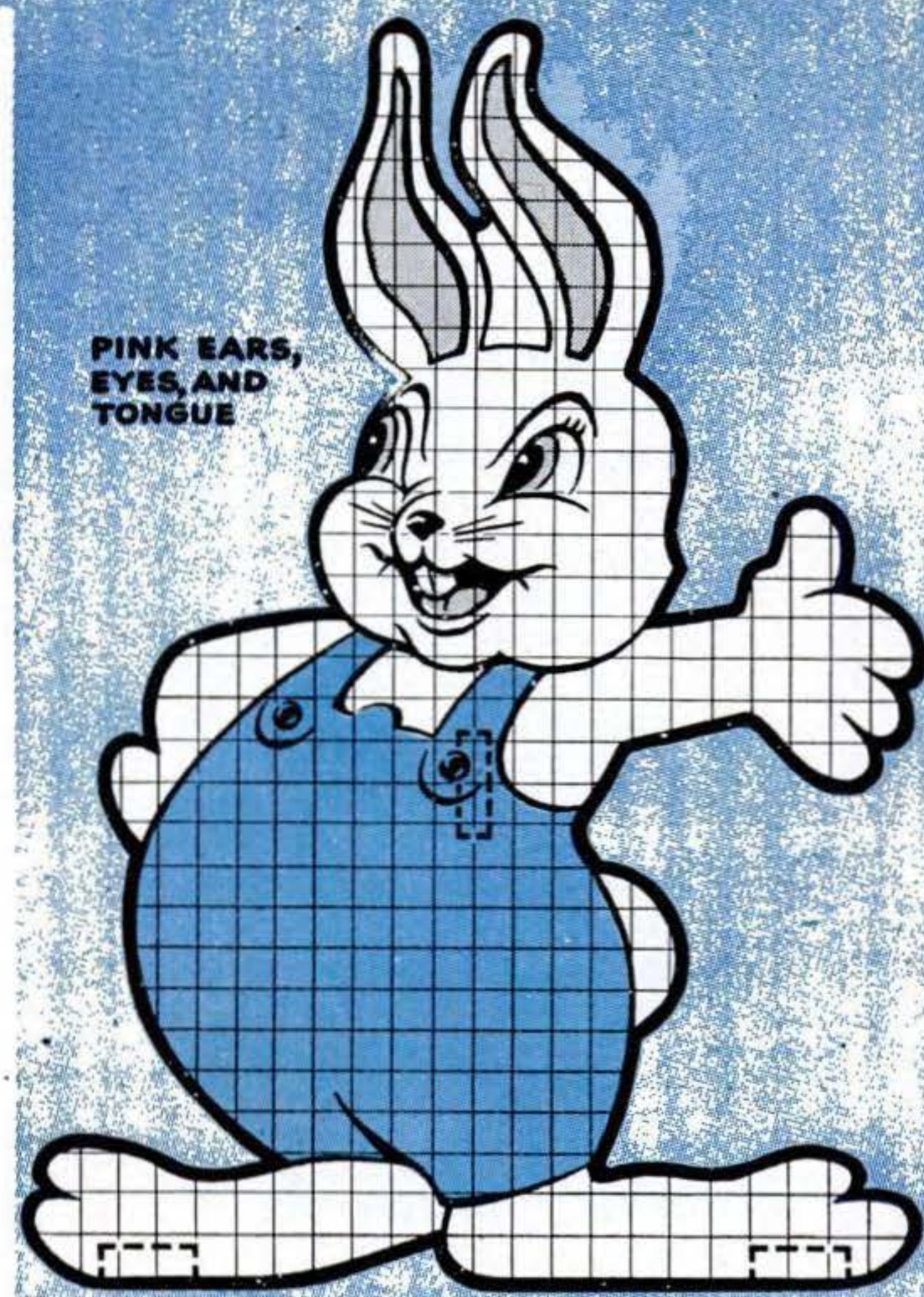
PARENTS who have a young baby will find this cradle has some special advantages. Not only can it be rocked in the best tradition, but a simple lock holds it steady when you wish. The cradle part can be lifted from the rocker stand and carried in a car in place of a basket, and at your destination may be put on two chairs for the baby to sleep in. It's big enough—32½" long—for use until a baby is quite large. The cradle is shown in color on page 117.

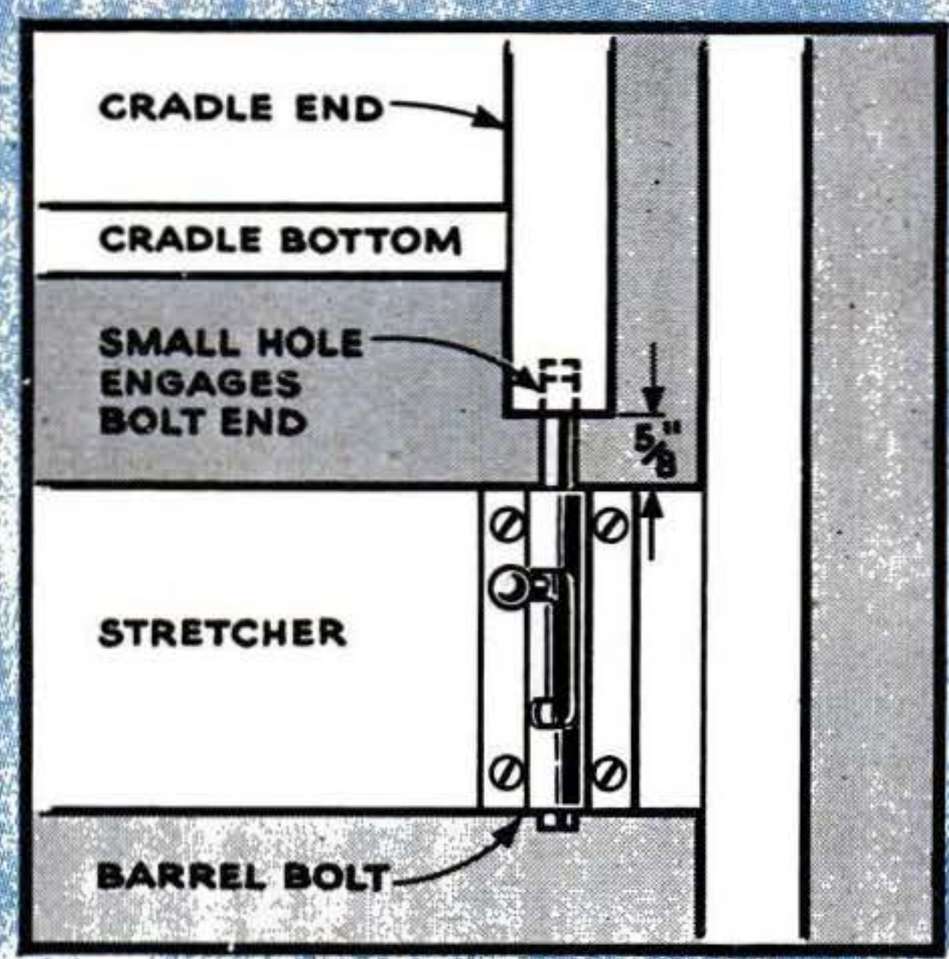
Anybody can make this project in just a few evenings. Saw the sides and bottom of the cradle itself from ½" plywood, and the ends from ¾" plywood. Assemble with screws and glue, rabbeting the bottom into the ends and sides. Stove bolts through the ends serve as rocker pivots and drilled dowels as spacers. Pad the sides, bottom, and ends, and cover with white imitation leather glued at the edges and decorated with blue upholstery nails. The fabric can be cleaned with a damp cloth.

Transfer the design for the bunnies to ¾" plywood panels and bandsaw them to shape. Round the notch between the ears to receive the rocker pivots. Lining with sheet metal (tin-can stock will do) resists wear. Don't cut between the lower part of the ears as this would weaken the piece.

The stretchers may be tenoned into blind mortises, if desired, but long wood screws and glue will hold satisfactorily. If the top stretcher is found to be too high, shallow notches cut where the ends of the cradle pass will provide room for plenty of swing. The brake is a barrel bolt screwed to the top stretcher and slipped in a hole in the bottom of one end. Roller casters on the lower stretchers, preferably the large, rubber-tired variety, will let you move it easily.

Finish the cradle and stretchers with shellac to show the grain. The bunnies may be enameled blue and pink on white, with black accenting eyes, ears, and overalls. Furniture dome casters will serve to make the shiny buttons on the overalls.





BRAKE DETAIL

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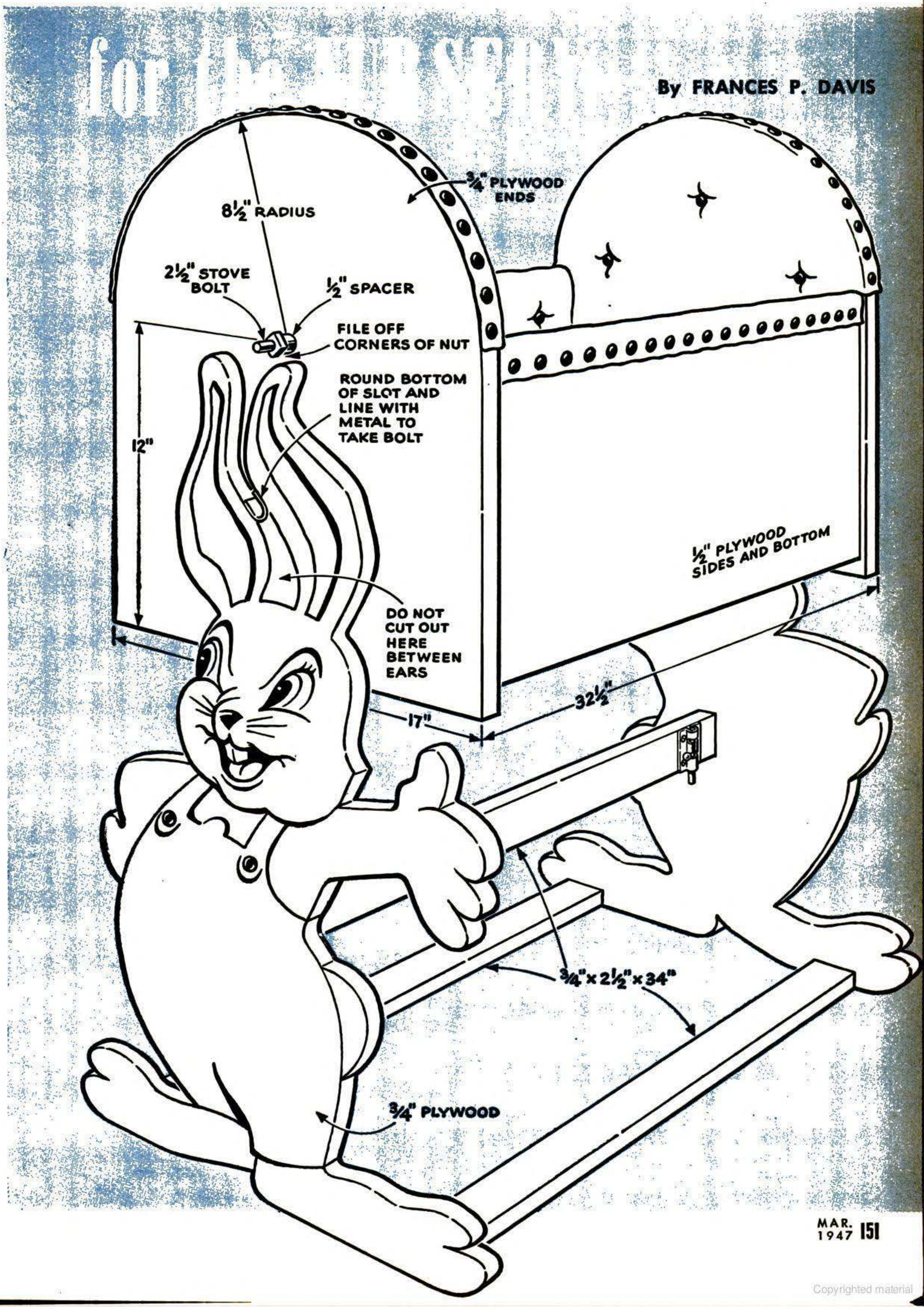
for the top seat

By FRANCES P. DAVIS



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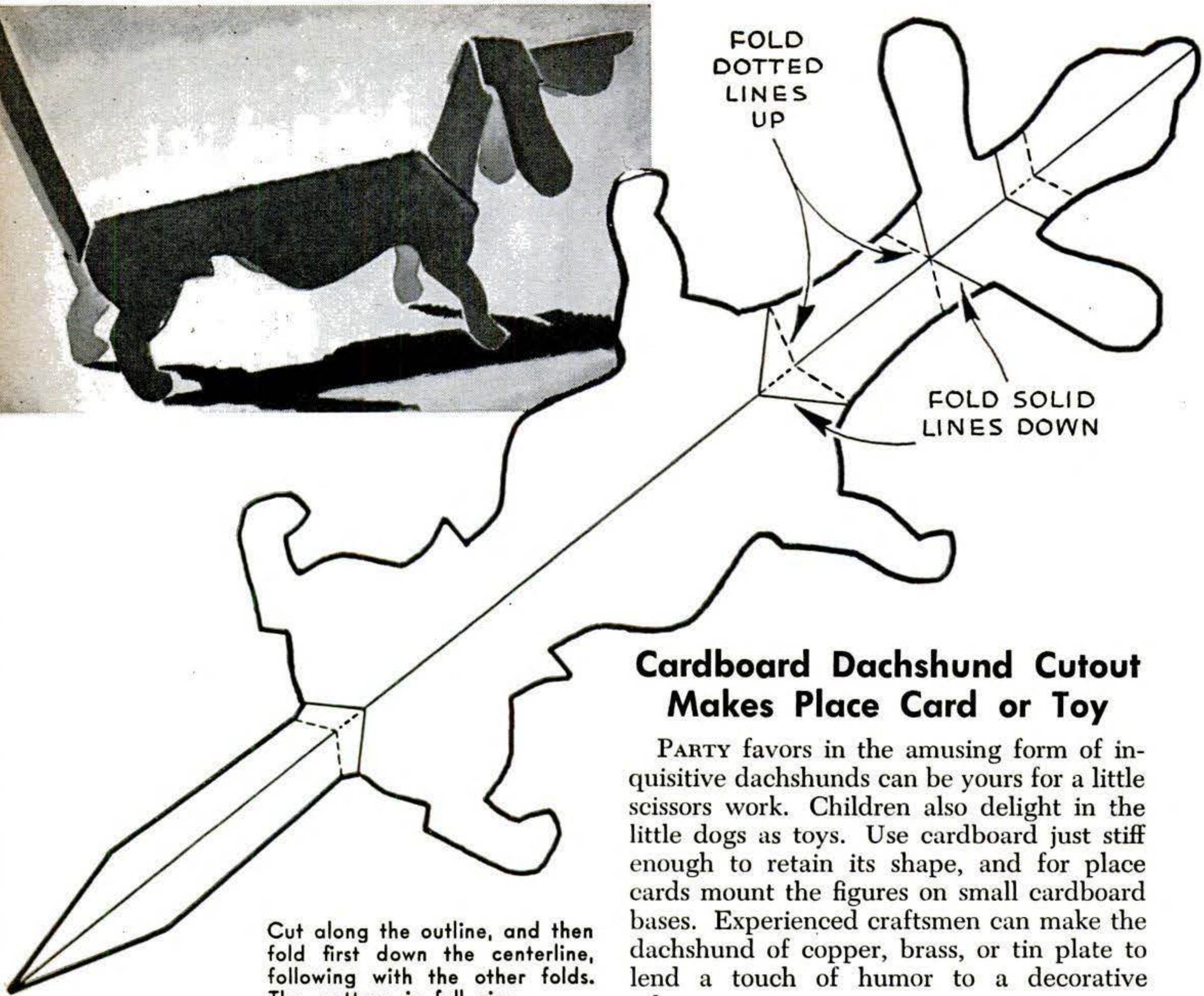


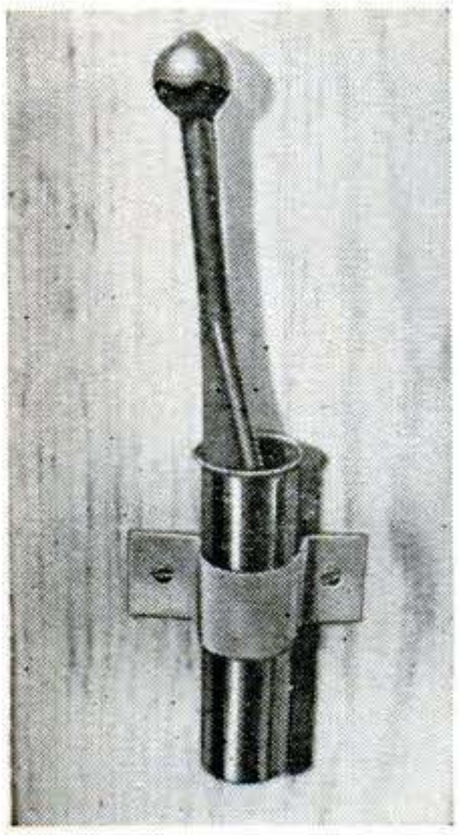
Cut along the outline, and then fold first down the centerline, following with the other folds. The pattern is full size.

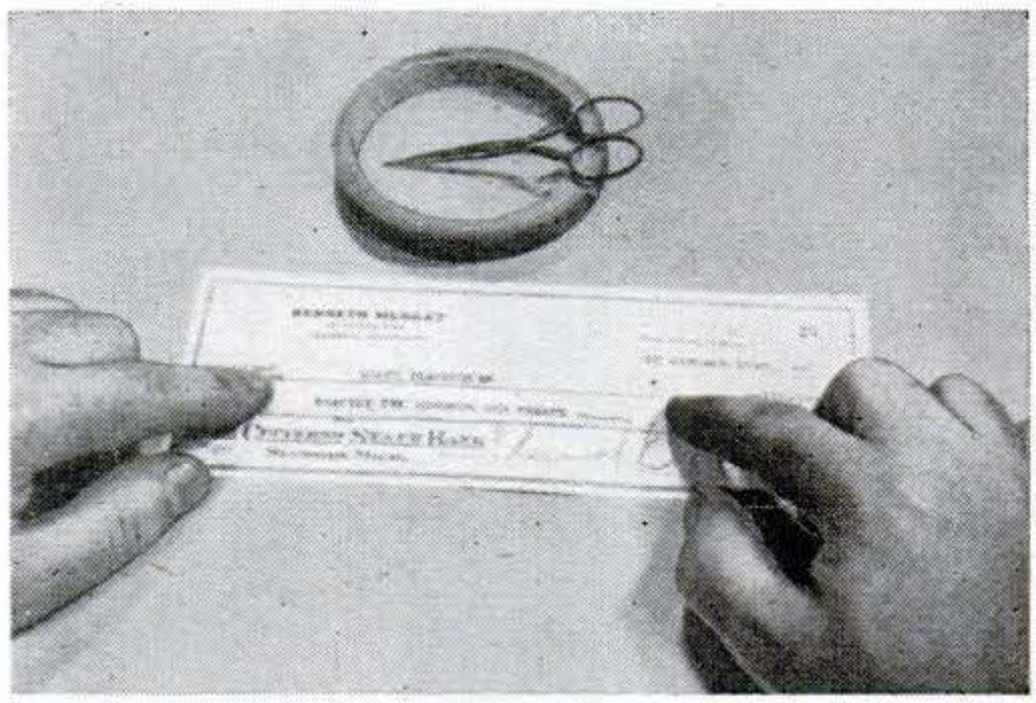
Cardboard Dachshund Cutout Makes Place Card or Toy

PARTY favors in the amusing form of inquisitive dachshunds can be yours for a little scissors work. Children also delight in the little dogs as toys. Use cardboard just stiff enough to retain its shape, and for place cards mount the figures on small cardboard bases. Experienced craftsmen can make the dachshund of copper, brass, or tin plate to lend a touch of humor to a decorative scheme.

Rustless Glass-Cutter Holder

ATTACHED to a wall by means of a sheet-metal strip, a length of metal tubing makes a convenient holder for a glass cutter. The tubing should be large enough in diameter for the cutter to go in, and 1″ or so longer than that part of the shank holding the wheel. Solder a metal disk to the bottom and push a cork down from the top to cushion the cutting wheel; then pour in light machine oil or medium oil thinned with kerosene to protect the cutter against rust.—WILL THOMAS.





Tape Prevents Check Raising

ALTERATION of the amount of your personal checks will be impossible if you cover the wording with a thin strip of transparent cellulose adhesive tape. The lettering, of course, cannot be changed through the tape, and if an attempt is made to remove the tape, it will tear away the surface fibers on the check paper.—KENNETH MURRAY.

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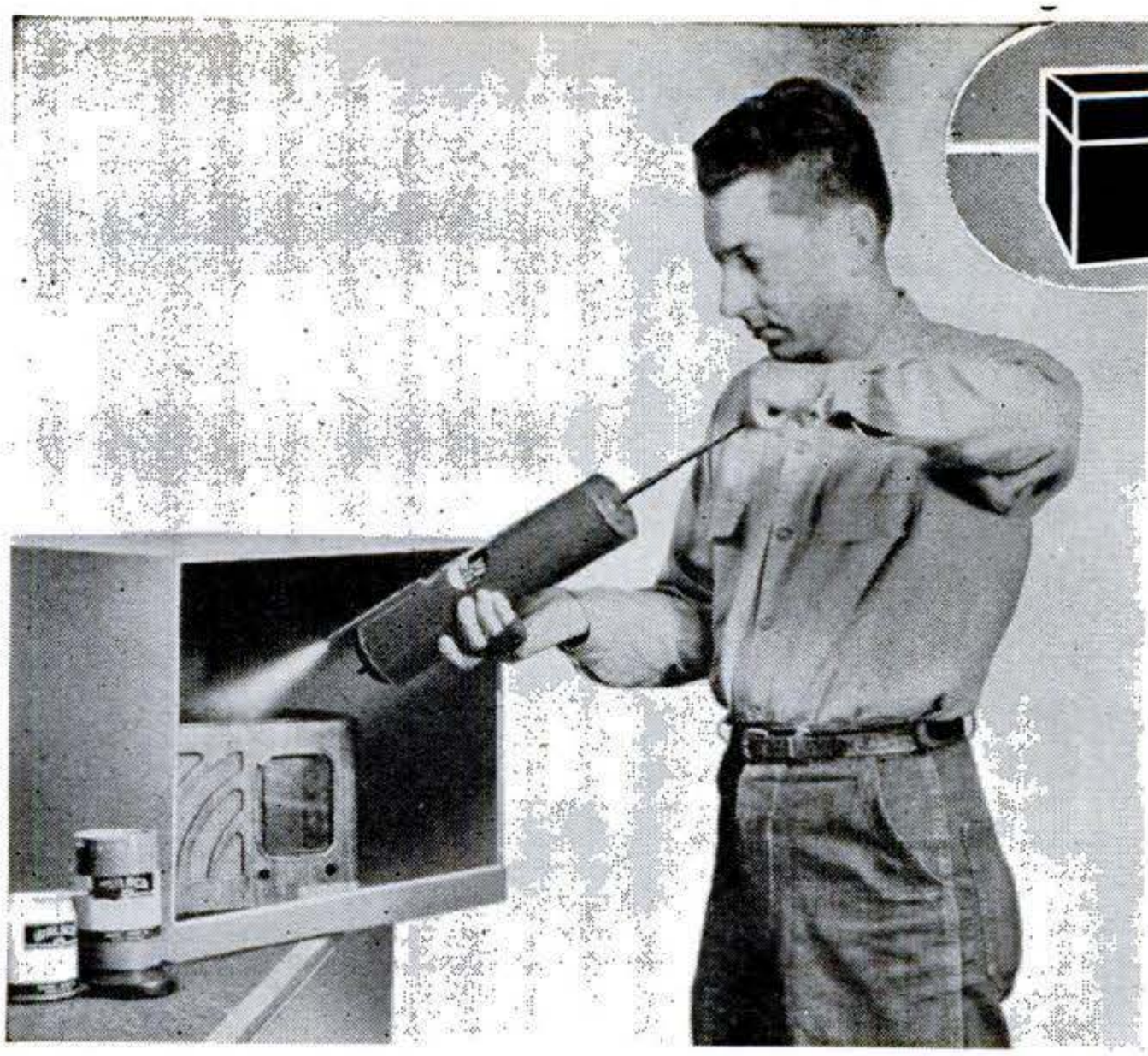
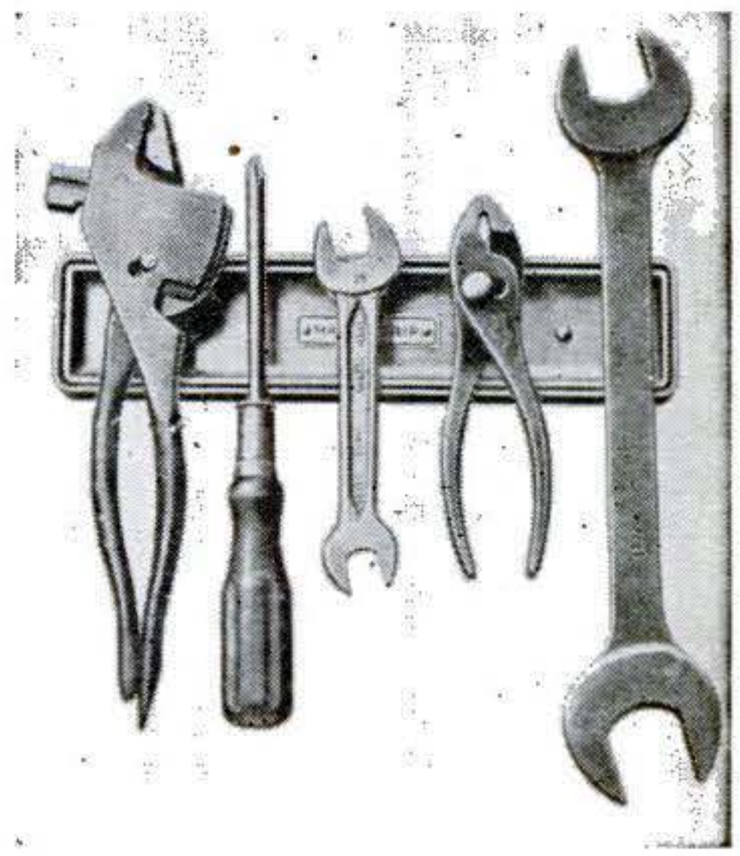
NEW TOOLS

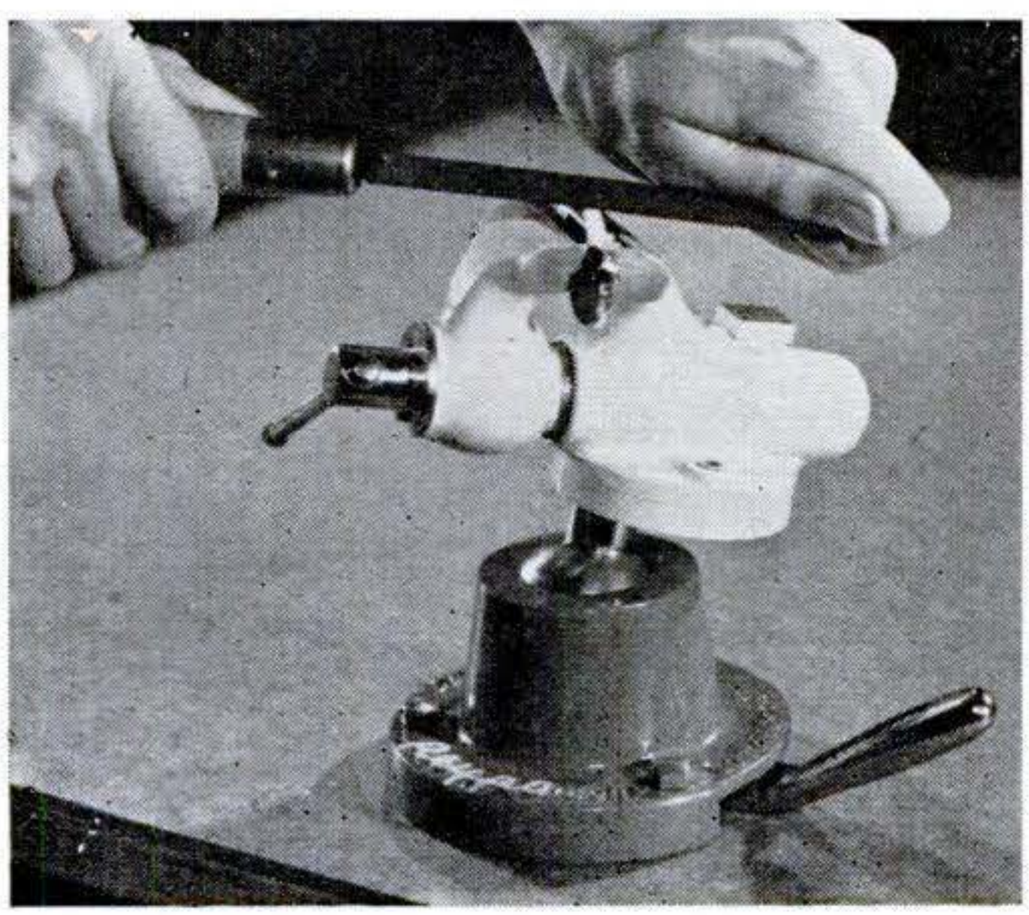


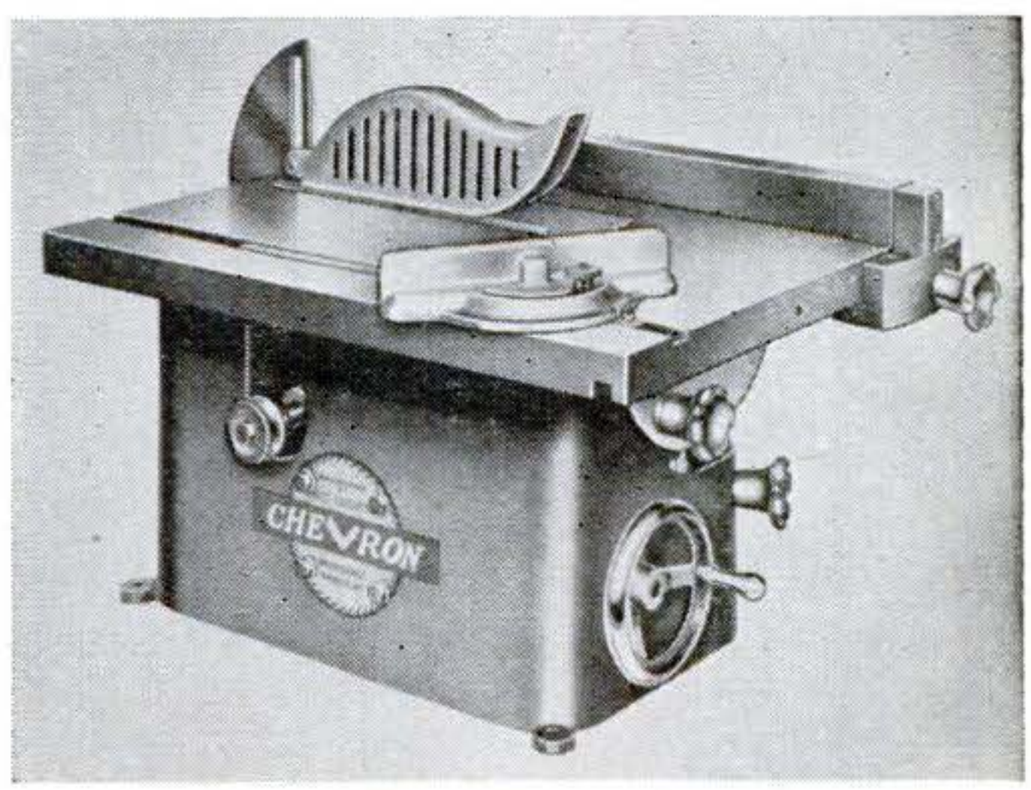
TOOL HOLDER. Mounted on the wall above a workbench, the Magnagrip, a magnetic rack, provides a means of keeping metal tools handy. Manufactured by R. E. Phelon Company, Springfield, Mass., it also can be used in the kitchen to hold knives.



FELT-FLOCK SPRAY GUN. Velvety coatings of felt flock may be easily applied to radio-speaker grilles, turntables, instrument cases, toys, show cards, and other items with a spray gun produced by the Walter L. Schott Co., of Beverly Hills, Calif. Propelled at high velocity by the gun, the flock particles embed themselves in a previously applied undercoat. The manufacturer provides a choice of eight colors—brown, ivory, blue, taupe, red, green, gray, and white.

TILTING VISE. A ball vise manufactured by the Reypo Corporation, of Los Angeles, has a base so designed that the vise can be instantly locked at any angle. The 2″ jaws open to 2¼″, while the throat depth is 1½″. The body is entirely closed to keep out dust and chips.





SAW HAS DEEP CUT. A table saw offered by Peerless Precision Products Co., of Providence, R. I., has a cutting capacity of about 2 11/16″ with an 8″ blade. A 14″ by 18″ cast-iron table that tilts to 45 deg., a cast-iron fence that is adjustable for alignment and reversible for use on either side, an aluminum miter gauge, and an aluminum guard are other features. Extra equipment includes a selection of dado heads.

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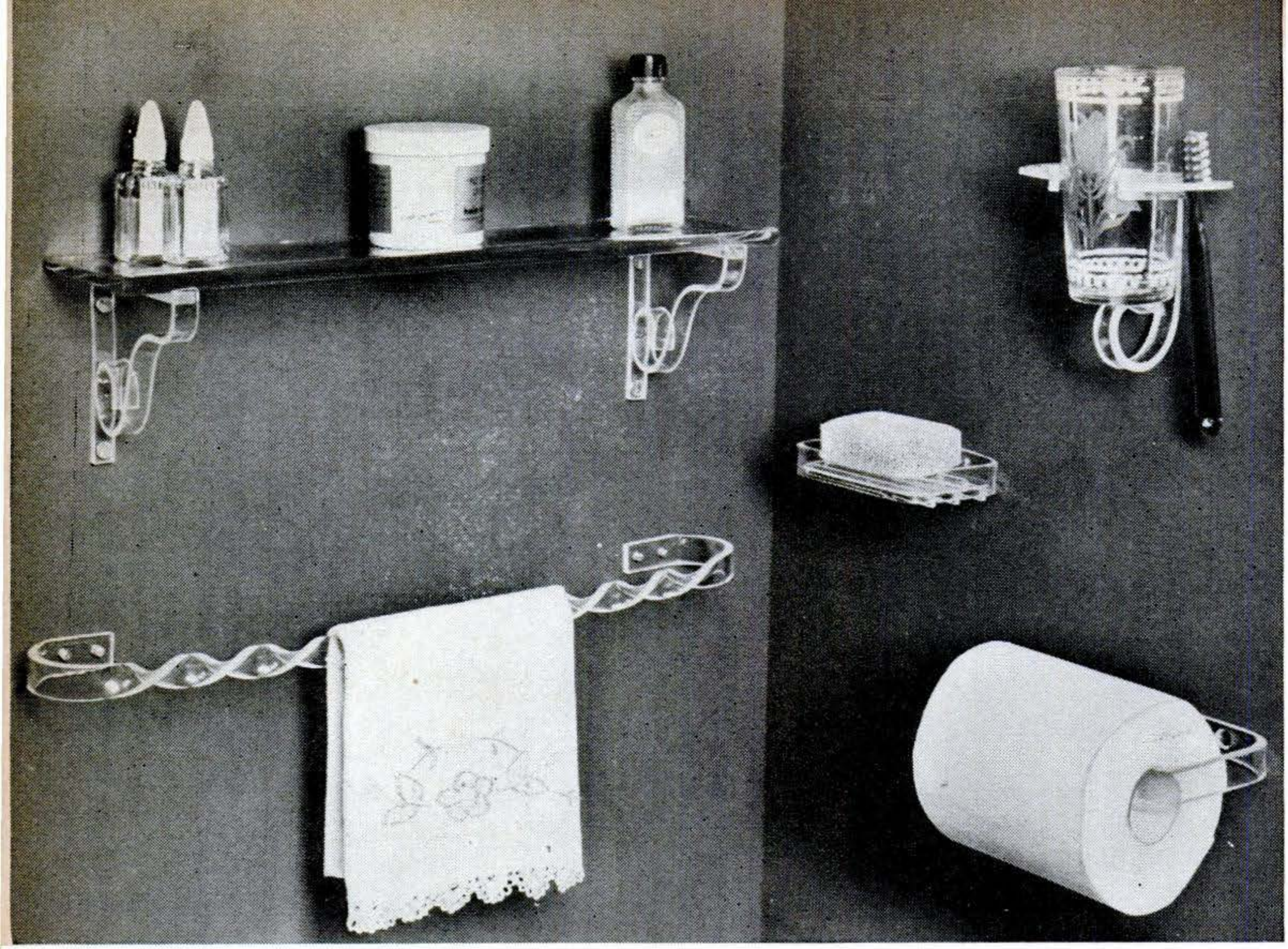

All of these bathroom accessories may be made of transparent plastic, either crystal or colored. The shelf shown here is glass.

Make Your Own Plastic Bathroom Fixtures

By JOHN P. ARNOLD

BATHROOM fixtures of transparent acrylic plastic present a fine appearance and are as durable as anything you can buy. For this five-piece set—towel bar, soap dish, shelf brackets, tissue-roll holder, and toothbrush and tumbler holder—you need only a few scraps of plastic.

A hot-air oven with a temperature regulator is satisfactory for simple forming, the optimum working temperature ranging from 250 to 300 deg. F., depending on the thickness of the material. Molding forms may be cut in ¾″ pine plywood with a jigsaw. If you use crystal plastic, frost the edges with fine sandpaper. Colored plastics look better if all of the edges are buffed to a high polish.

For the towel bar, the plastic stock should be quite substantial, especially if it is to be more than 16″ long. Such sizes as ⅜″ by ¾″ and ½″ or ¾″ square are good, the length being several inches more than the finished product so that the ends, which the clamps will mar, can be cut away after the stock has cooled.

Although the bending form (Fig. 1) might be considered too crude for production work, it serves its purpose quite satisfactorily. Two blocks of ¾″ plywood are cut as indicated and then aligned and attached to the baseboard so that each overhangs slightly to allow clearance later for the twisted portion of the bar. Separation of the blocks will be

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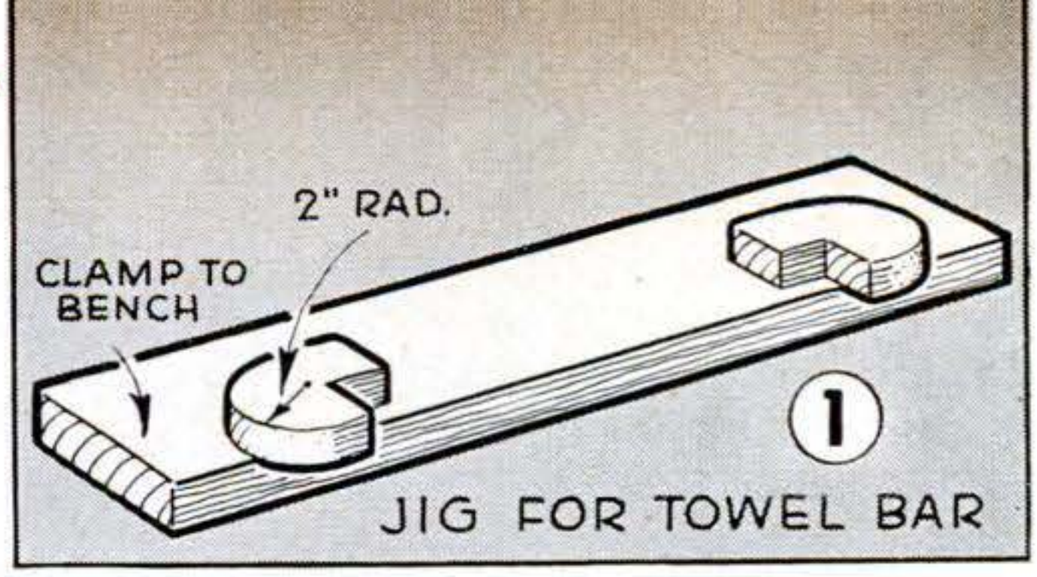
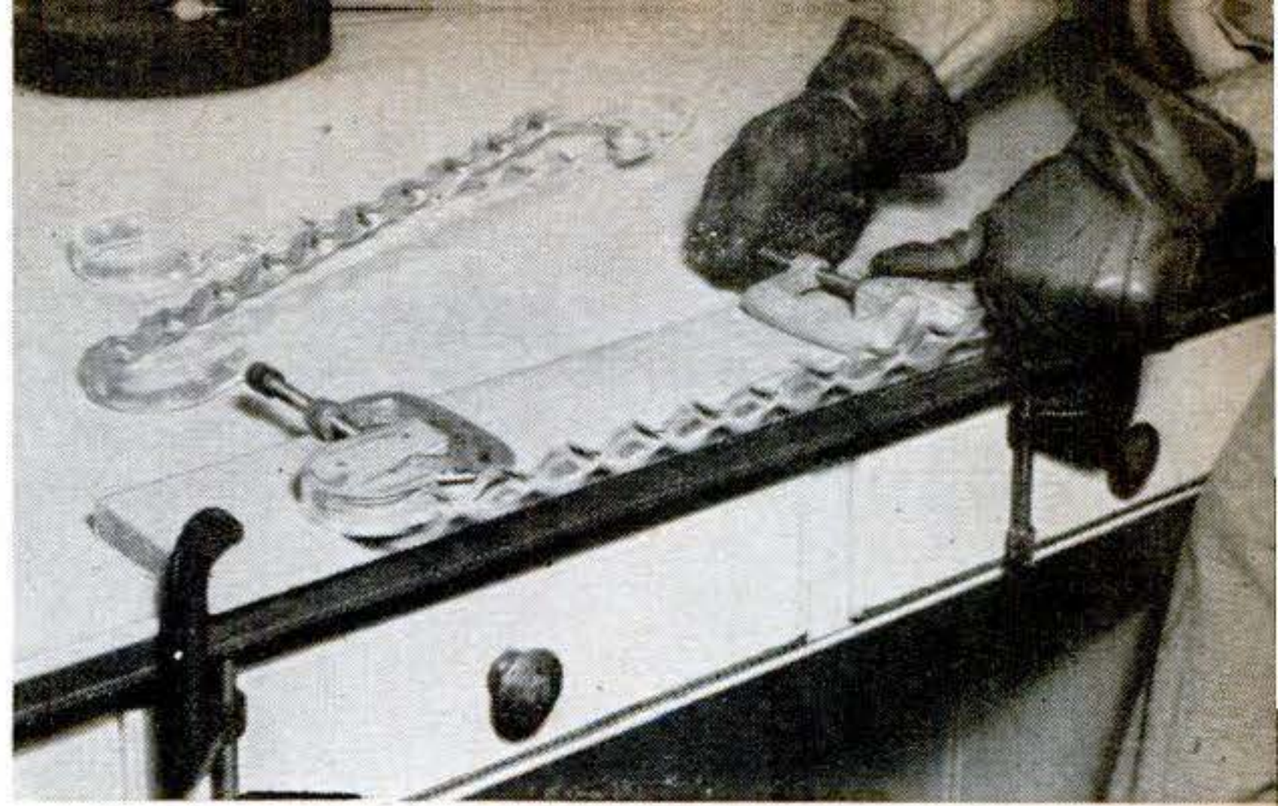


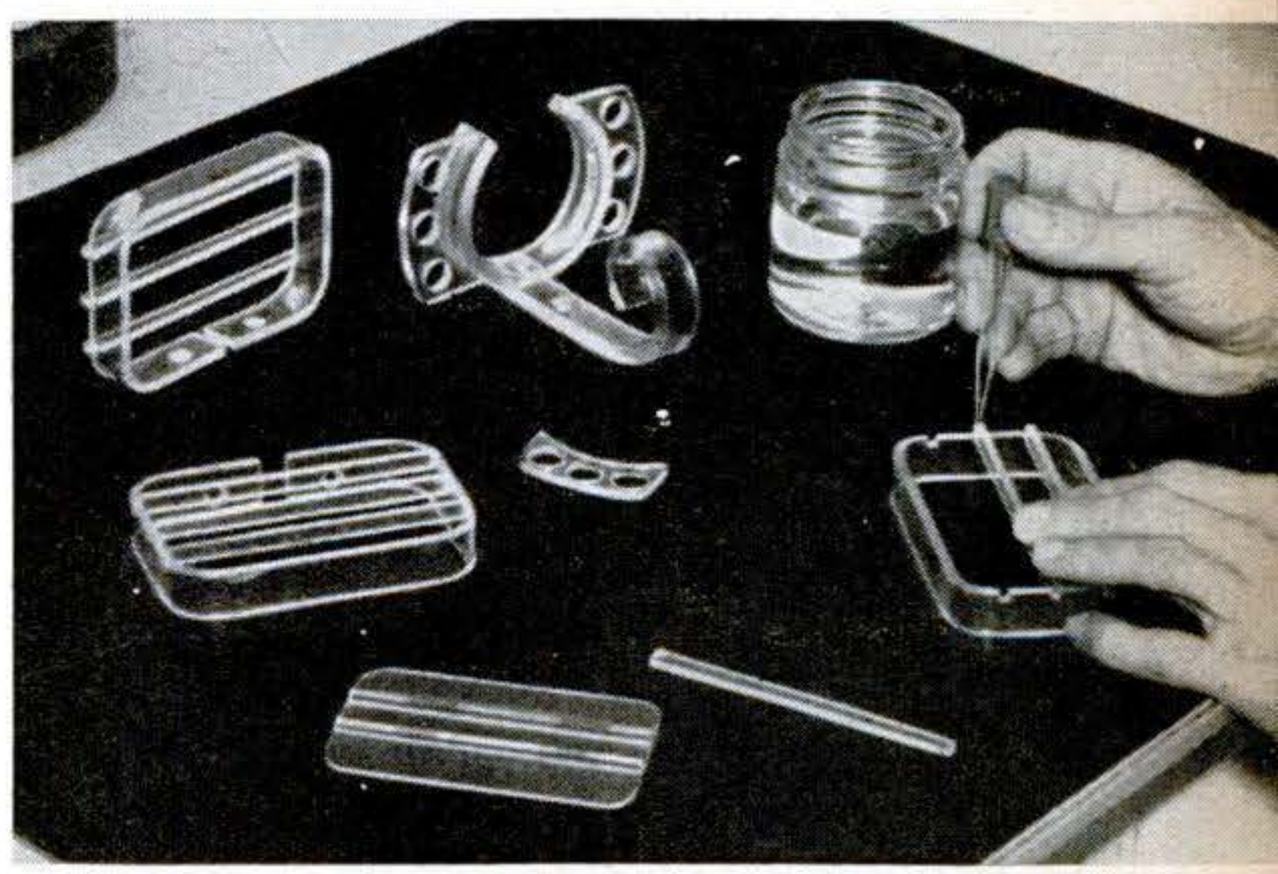


Heated to 250 or 300 deg. F., the towel bar may be twisted into a graceful spiral. Here, the end is being clamped to the jig as the final forming operation. Notice that heavy gloves are needed.

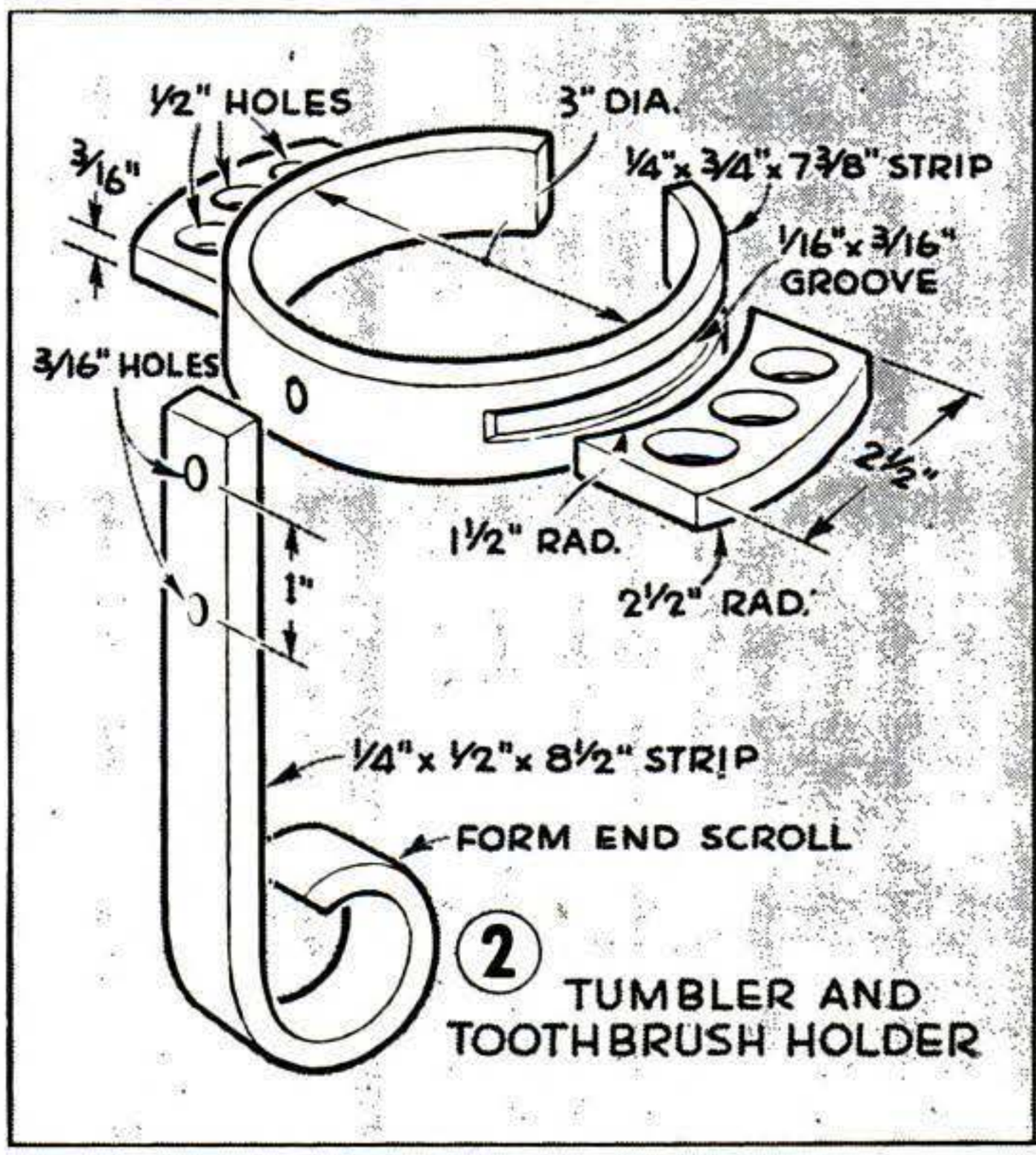
governed, of course, by the predetermined length of the bar.

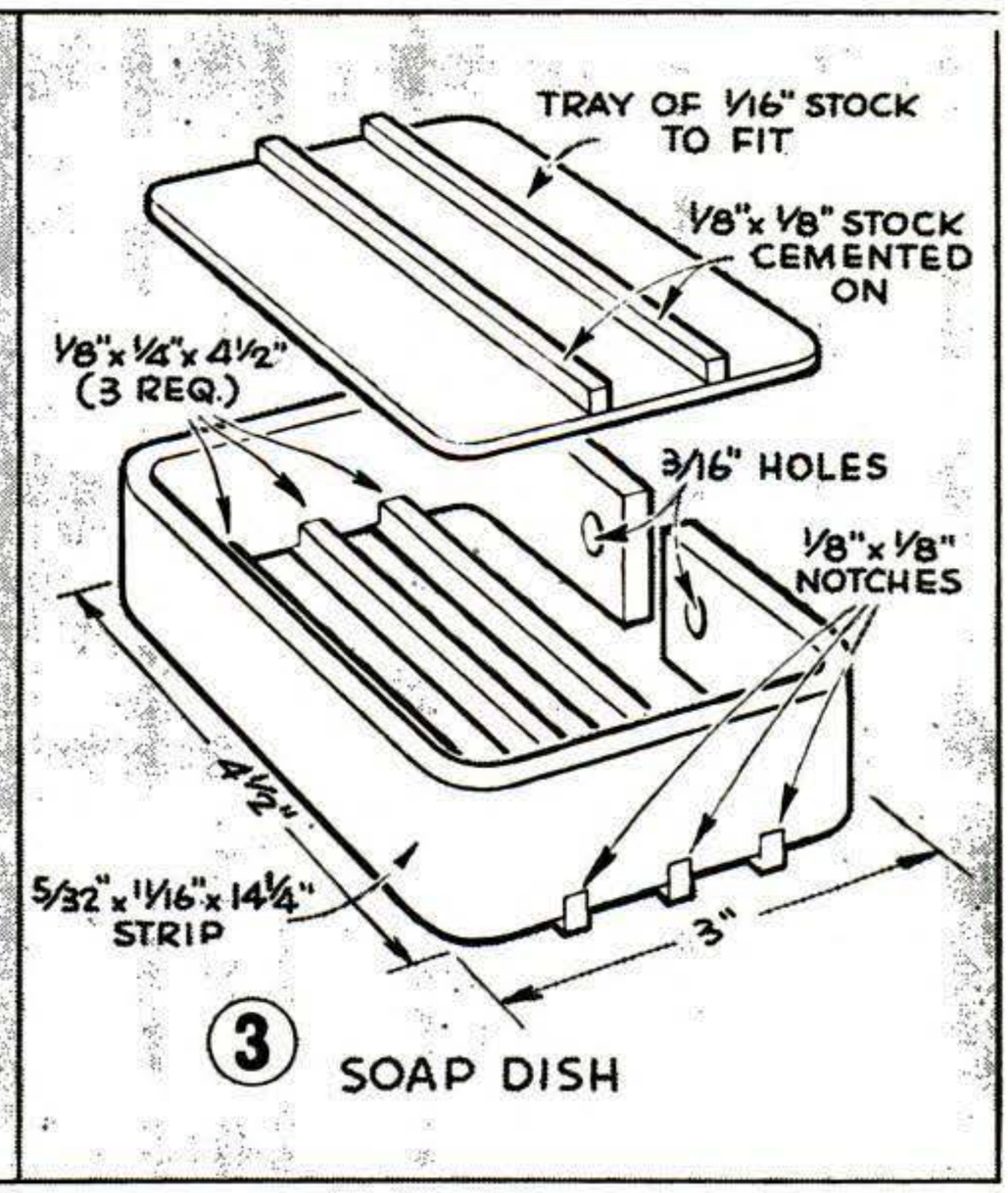
Of all the fixtures to be made, the towel bar involves the only forming operation where the plastic must be in the optimum working condition; that is, it should be subjected to prolonged heat in the oven until it attains maximum flexibility. Then one end should be clamped to the inner side of one of the blocks and brought around the curved portion. While the plastic is held against the outer edge of this block, six or more twists are taken in the material, and, after the twisted section has been stretched taut, the second end is placed against the outer edge of the second block, carried around to the back, and clamped fast. If the first attempt is not satisfactory, the plastic may be reheated and formed again.

Two forms may be used for the tumbler and toothbrush holder (Fig. 2), although if desired the collar that supports the tumbler can be formed with ease around a tumbler of the size that is to be used. For the collar and scrolled support, saw two strips of ¼" plastic ¾" wide, the length of one being



Applying solvent cement with a medicine dropper gives a neater finished appearance. Of all such cements, ethylene dichloride is most satisfactory. Above, cementing bottom bars on the soap dish.





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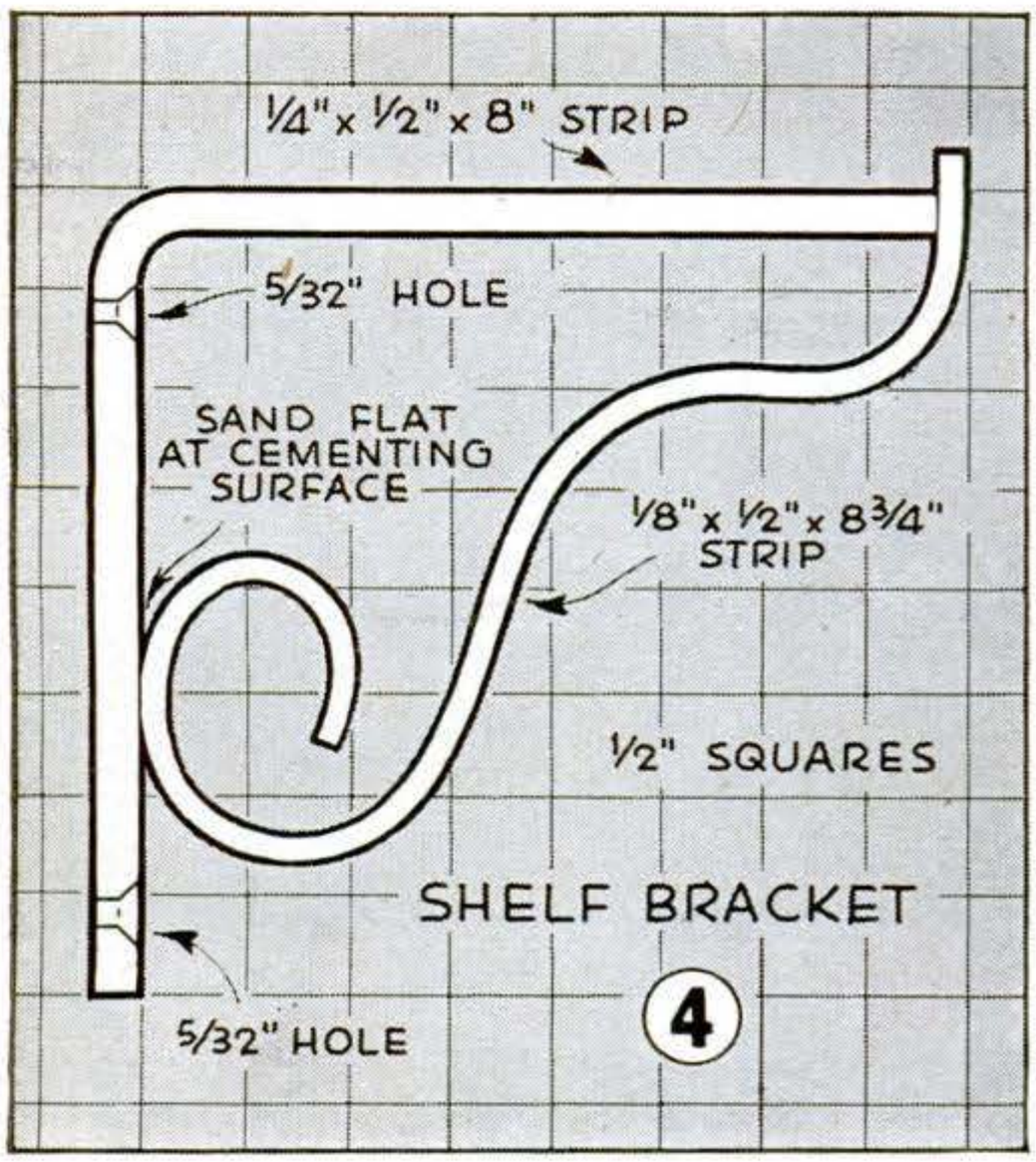
about 7⅜″ and the other about 8½″. (The exact length will depend on your forms.)

After edge-sanding both pieces, drill and countersink a 3/16″ hole in the middle of the shorter piece—the collar—and stop-groove it for 3″ from each end. This groove, 1/16″ deep and 3/16″ wide, can be cut either with a sharp dado saw or by successive kerfing with a common saw blade.

Drill two 3/16″ holes in the longer piece, one ⅜″ from the end and the other 1″ beyond the first. Wings for holding the toothbrushes are jigsawed from 3/16″ stock to fit the grooves in the collar, three ½″ holes being drilled in each to insert the toothbrush handles. Cement the finished pieces together with ethylene dichloride, applying it with a medicine dropper rather than a brush for a neater appearance.

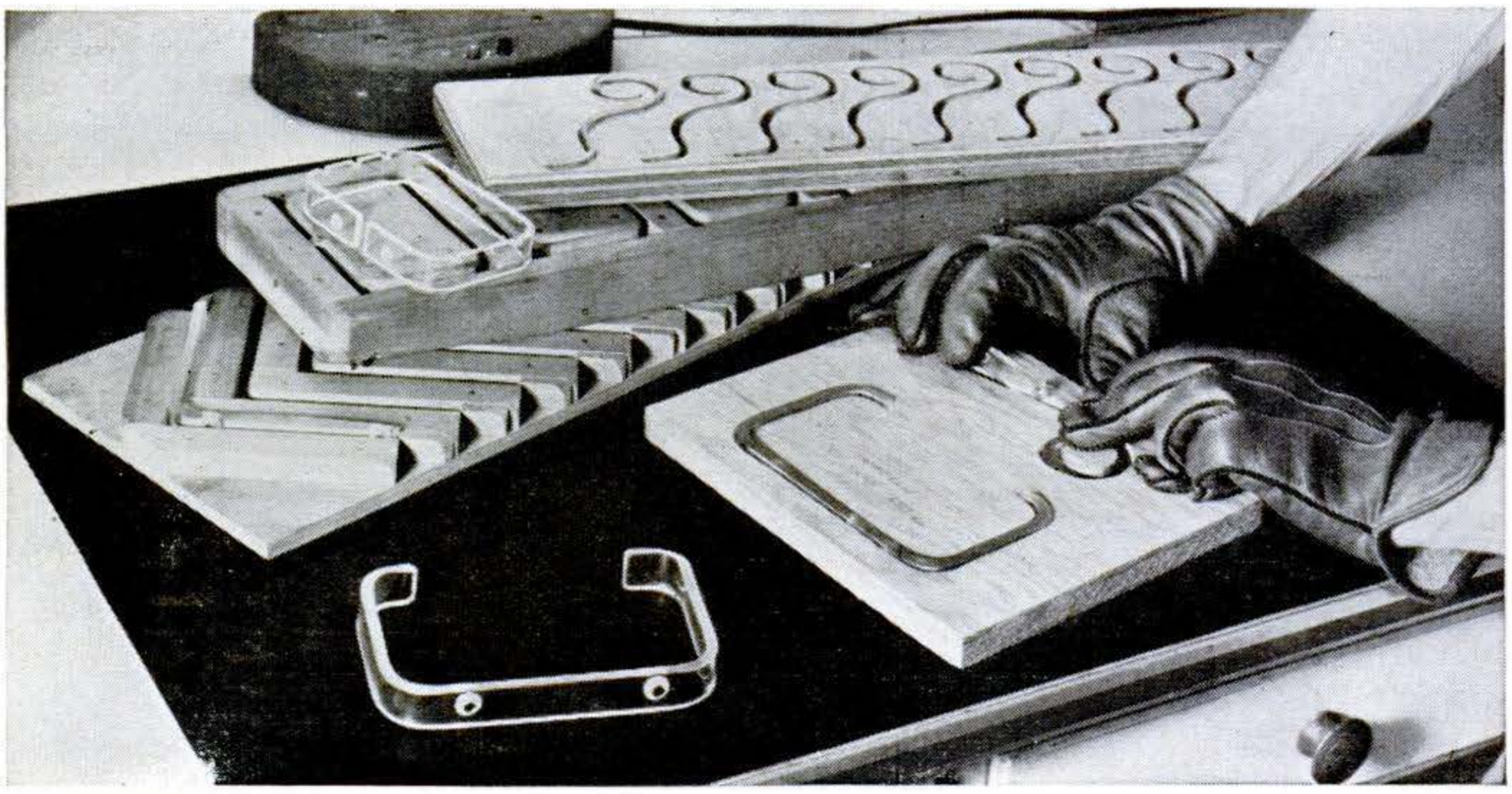


The soap dish (Fig. 3) is made in two parts, only one of which requires forming. After this piece has been drilled, sanded, and formed, the three ⅛″ by ⅛″ notches at each end for the supporting bars may be cut on a circular saw. Cement the flat bars edgewise into the grooves. Within this frame, a flat piece of 1/16″ stock (with two ⅛″ by ⅛″ strips cemented lengthwise on top) is fitted—but not cemented. Such a two-piece dish is readily cleaned.

Two forms are used for the shelf brackets (Fig. 4), one for the right-angle bracket and another for the supporting scroll. While cementing these pieces, apply a slight clamping pressure such as can be obtained with spring clothespins. If you wish, brightly finished drive screws may be used instead of cement to avoid any danger of the loaded shelf collapsing the brackets.

The tissue-roll holder is a simple bending operation, the holes for the supporting screws being drilled while the 3/16″ by 11/16″ by 13½″ strip is still flat. The form should be devised so that the arms of the bracket must be sprung outward slightly to fit into the ends of the cardboard tube of a standard roll of tissue.

Forms are cut in ¾″ plywood with a jigsaw, openings being made 1/16″ wider than the thickness of the plastic to be used. All of the surfaces that may touch the plastic should be sanded perfectly smooth.



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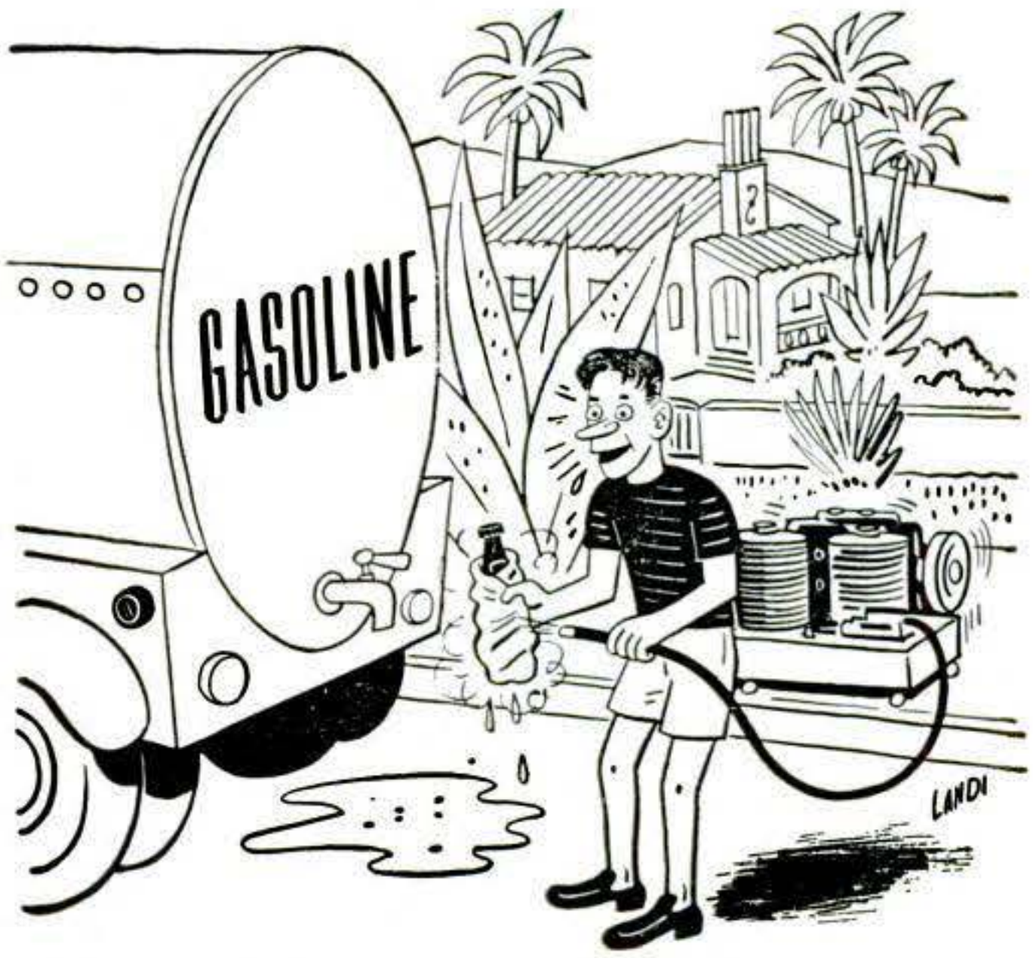
WHAT'S YOUR INGENUITY QUOTIENT? IQ

FAN ME DOWN! Grandma and her waving fan will have to take a backseat to me. I'm a movie fan who likes to be cool in a hot theater. But instead of waving a paper fan and getting tired, I take along an automobile defrosting fan and a 6-volt dry battery, place the battery on the floor, and with a zephyr in my lap sit through the show in cool comfort.—ALBERT J. EICHEL.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

IT'S THAW RIGHT! Yes, sir, my solution for a frozen automobile radiator works fine. I borrowed my wife's vacuum-cleaner hose, placed one end in the steaming radiator, and, with the hose, directed the steam against the bottom of the frozen radiator. The steam thawed it fast.—O. C. THOMPSON.



HOT TIP FOR A COLD DRINK. Caught short of ice on a hot day, I cooled my beer by wrapping the bottle in a towel, saturating it with gasoline, and evaporating the gasoline with compressed air. Only drawback—no smoking!—ROBERT J. ULLINY.

SINK THAT STOPPER! A stopper and its tarnished chain dangling in a wash basin or piled up in the soap dish always annoy me. In my bathroom, I removed the stud to which the chain is attached, slipped the loose end of the chain through the exposed hole, and fastened a weight on it. Now the stopper can be found in the same place and the chain is hidden.—JOHN J. ANTAL.

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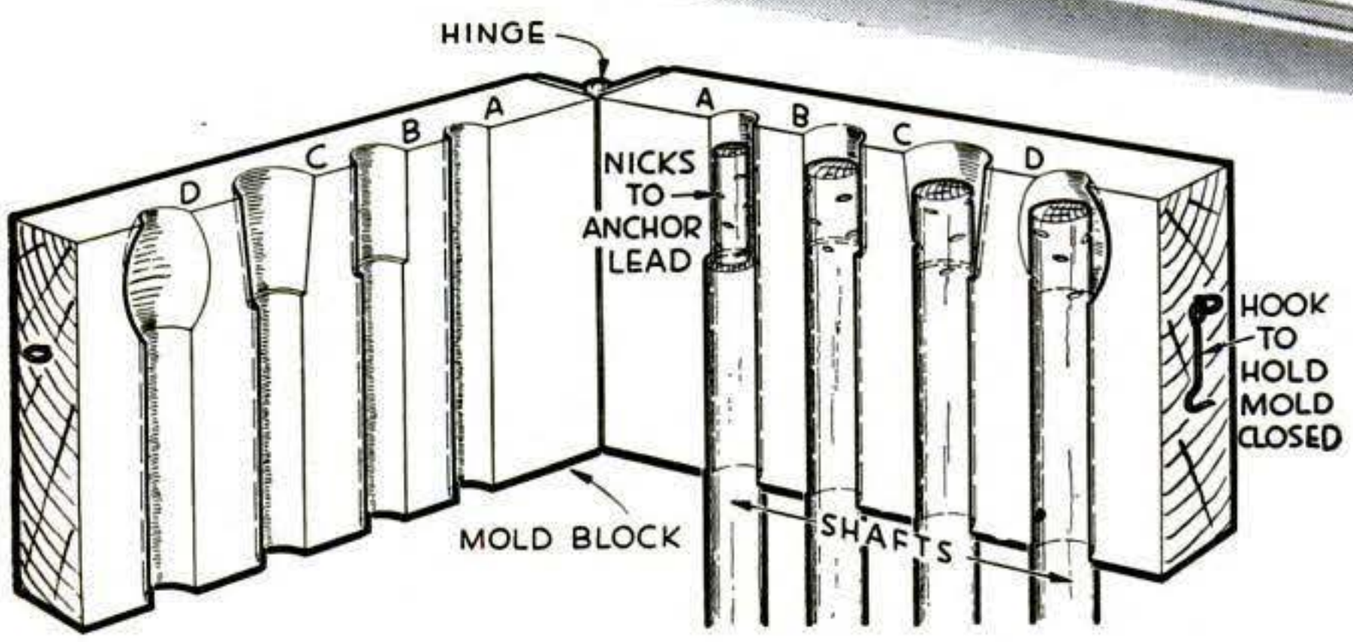
Lead-Tipped Arrows



With the shafts clamped ¼″ below the top surface of a hinged mold, metal tips can be poured on them. Nicks in the ends of the shafts anchor the heads.

BLUNT arrowheads for target, field, and small-game shooting can be readily cast of lead or other metals right on the end of the shafts by archers who like to make their own tackle. They are durable and efficient, and on at least three counts will be found to be superior to pointed arrows.

Used with a regular hunting bow, blunt heads molded on tough birch shafts deliver a terrific smash and will usually knock a squirrel or coon from a tree or stop a rabbit far more quickly than a sharp hunting head. Shot at game in a tree, a blunt head will not stick in the trunk or a branch like a pointed one. On a ground shot, a blunt-headed shaft is not so apt to go sneaking away under grass and become lost.

I can vouch for their effectiveness myself, having hunted both small and large game with the bow for more than 40 years.

Four styles of heads are shown here—a variety that will amply care for the needs of most archers. A shouldered shaft, *A* in the drawing, with the head the same diameter as the shaft, is primarily a target arrow. For roving shots at small game, where the arrow may strike stumps, rocks, and the like, the unshouldered *B* is less likely to be broken. *C* and *D* are variations of the hunting head —*C* cone shaped and *D*, really the best of all for small game, acorn shaped.

A mold for the heads is made from two blocks of hardwood hinged together at one end and fastened at the other with a hook and eye. Drill straight through the centerline of the joined faces holes the exact diameter of the arrow shafts. For *A* nothing further need be done. *B* is counterbored ⅛″ larger for a depth of about 1″. *C* is shaped with a tapered reamer, the mouth being about ⅝″ larger than the shaft bore. *D* is carved and then smoothed with sandpaper on the rounded end of a dowel, or a cone can be poured and the finished head filed round.

Secure the shafts in the mold and support it vertically and level. Pour full of lead, solder, tin, zinc, babbitt, type, or other metal that can be melted in an iron ladle over gas. Finish with a fine file. If the heads become deformed after hard use, they can be put back in shape easily with a hammer.—JIM RAMSEY.

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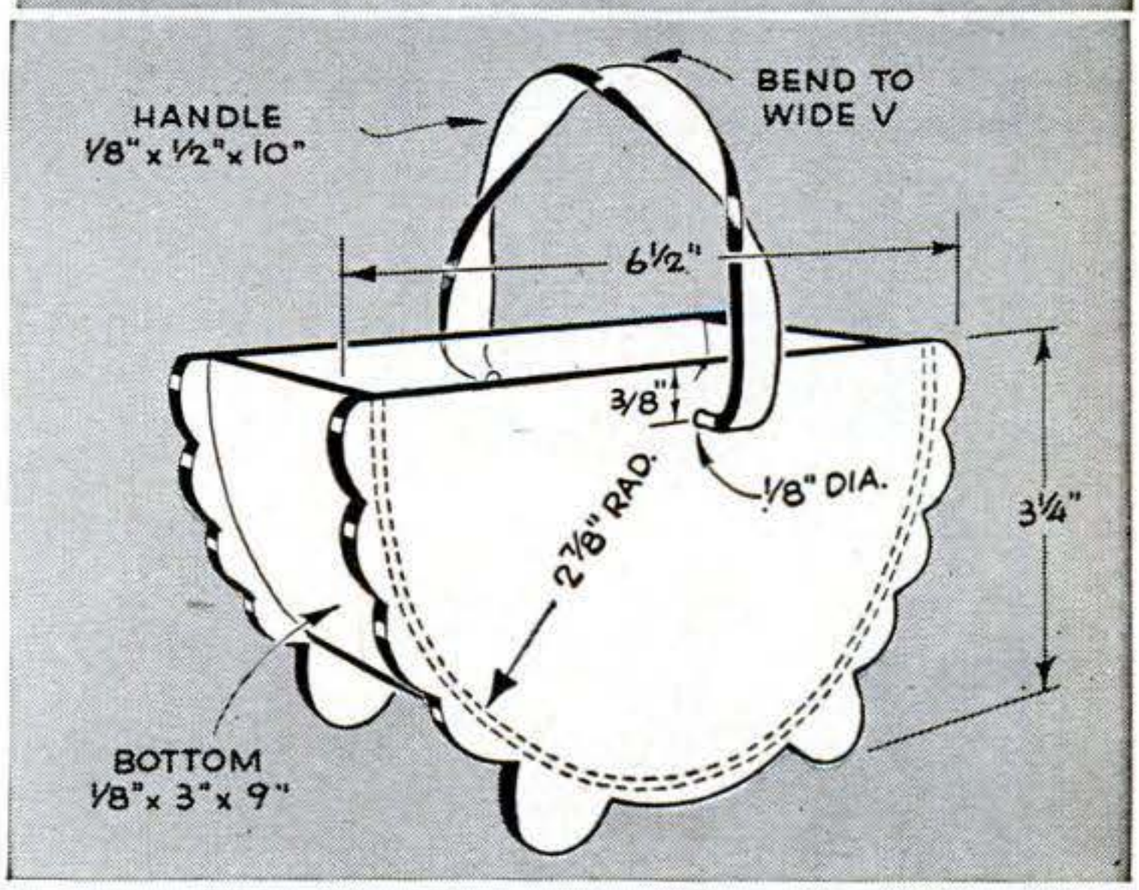
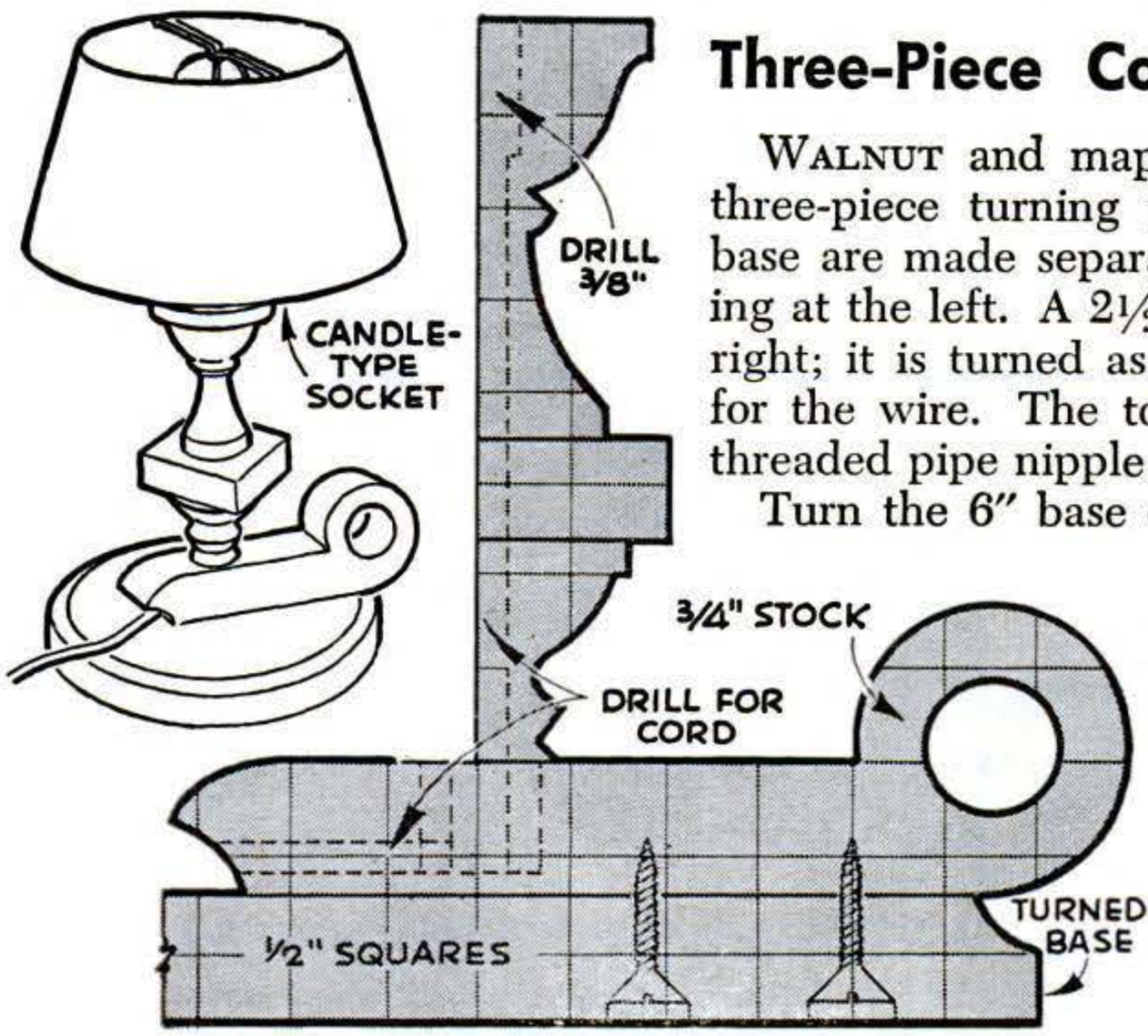
Plastic Basket Serves Cigarettes or Candy

FOUR pieces of crystal-like plastic form a dainty serving basket for napkins, candy, cigarettes, or nuts. The inside of the handle holes as well as the scalloped and top edges are colored with a plastic dye; red was used here, but almost any color will prove effective.

To make the sides, lay out the design on the masking paper already on the ¼″ stock, saw them out, and drill the handle holes. Polish the edges and apply the dye before removing the paper. The bottom is cut to size from ⅛″ sheet. Balance the piece on top of a round form (a large fruit can has the right radius), place the plastic and form in an oven, and heat to 250 deg. As the plastic becomes warm it falls naturally into shape; the ends may have to be held down while it cools. Cement the bottom to the sides.

Clamp the ends of a ⅛″ by ½″ by 10″ handle strip with spring clothespins. Heat the strip and, using the clothespins as handles, twist and bend it to shape, finally bending the parts held by the clamps inward at right angles. Plastic must be worked quickly for it remains pliable for only a short time. It can, however, be reheated and reworked.—ELMA WALTNER.





Three-Piece Colonial Candlestick Lamp

WALNUT and maple are equally satisfactory for this three-piece turning project. The upright, handle, and base are made separately as shown in the outline drawing at the left. A 2½″ turning square is used for the upright; it is turned as a unit and drilled its entire length for the wire. The top is also counterbored ⅜″ for the threaded pipe nipple used to support the socket.

Turn the 6″ base on the faceplate and apply a sealer coat while it is still in the lathe. For the handle, ¾″ stock is cut to shape and bored for upright and cord. Screw the handle to the base and glue the upright into position; then lacquer and wax the assembly before installing the socket. Top the bulb with a clip-type lampshade of suitable size and pattern. —RICHARD HANSON.

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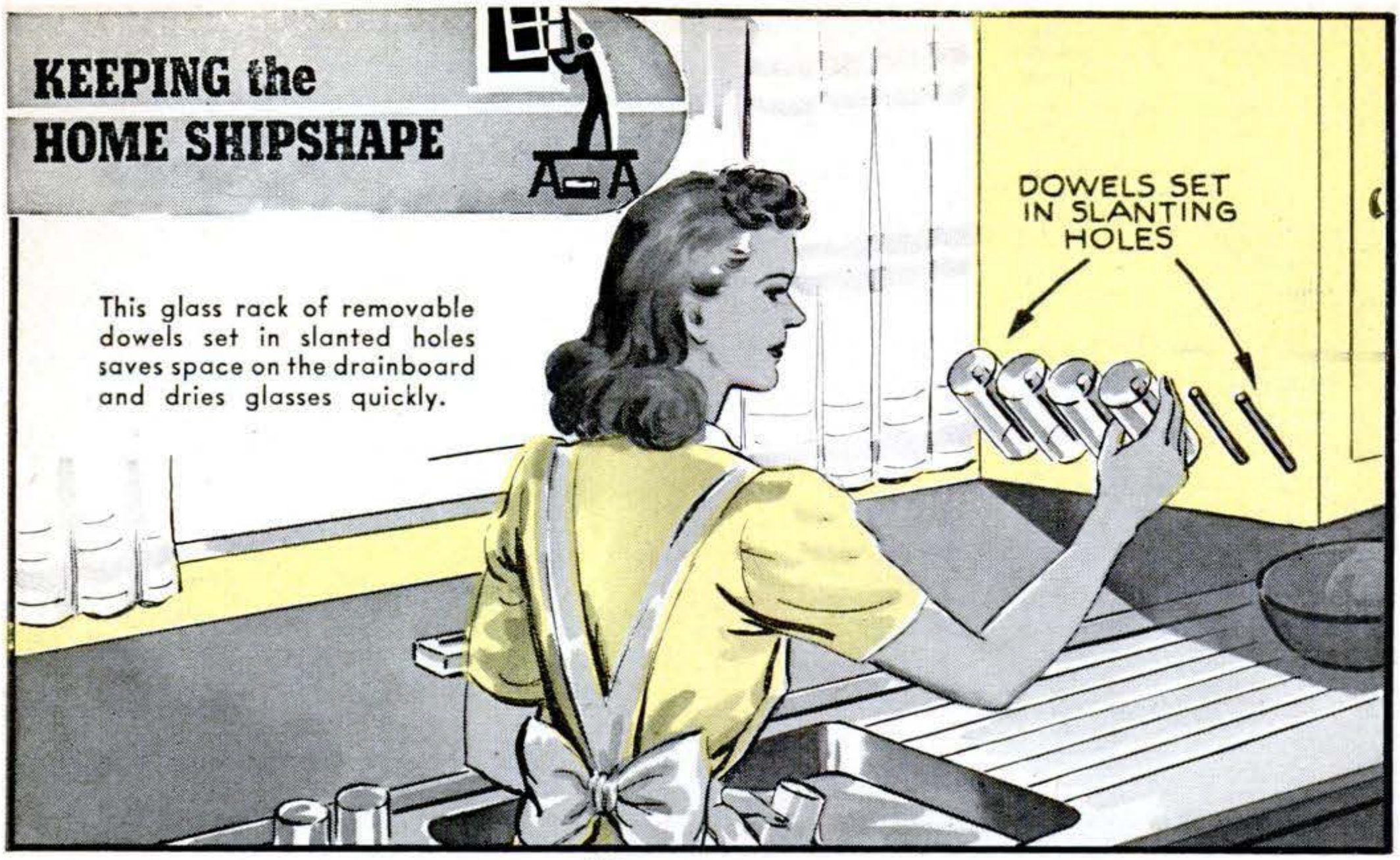
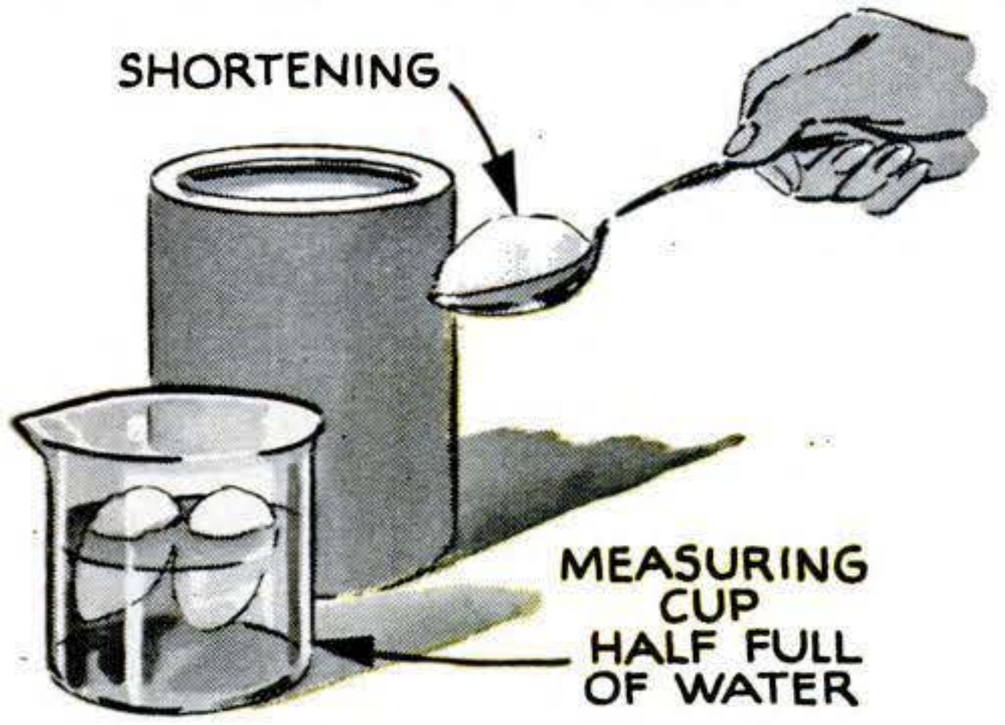
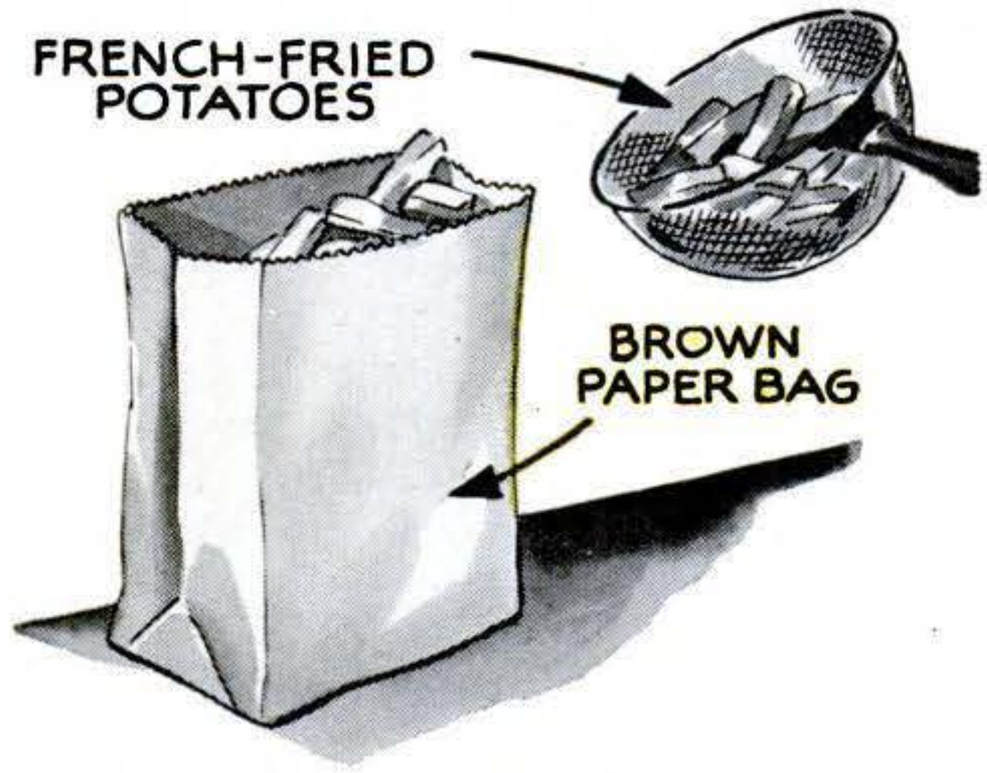
KEEPING the HOME SHIPSHAPE



This glass rack of removable dowels set in slanted holes saves space on the drainboard and dries glasses quickly.

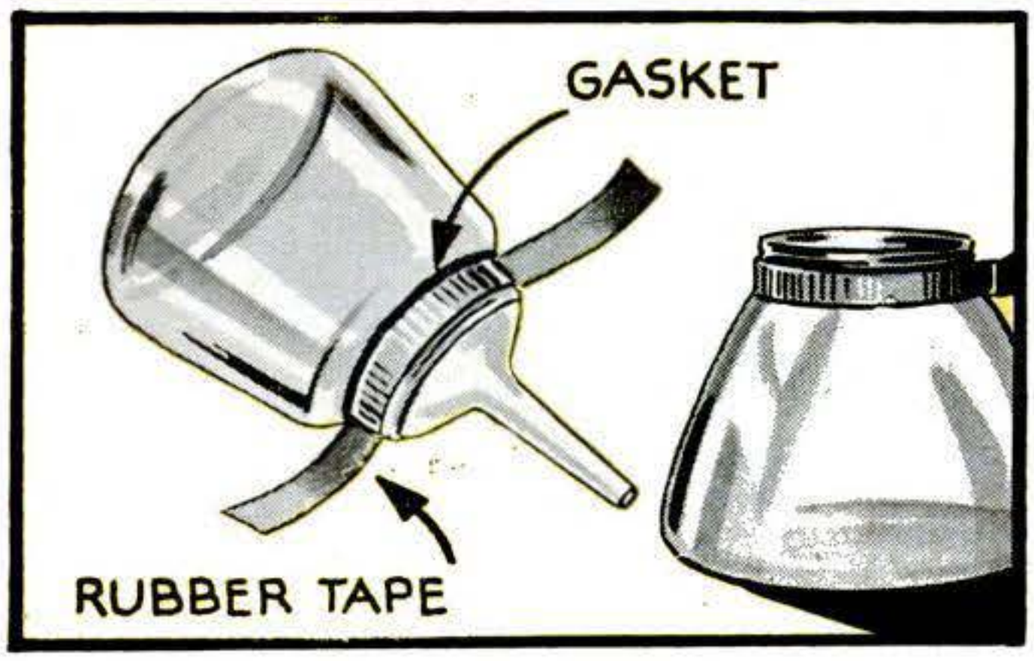


To measure half a cup of shortening, drop spoonfuls into half a cup of cold water until water reaches the brim. For other fractions fill the cup with water accordingly, and for a cupful measure two half cups.

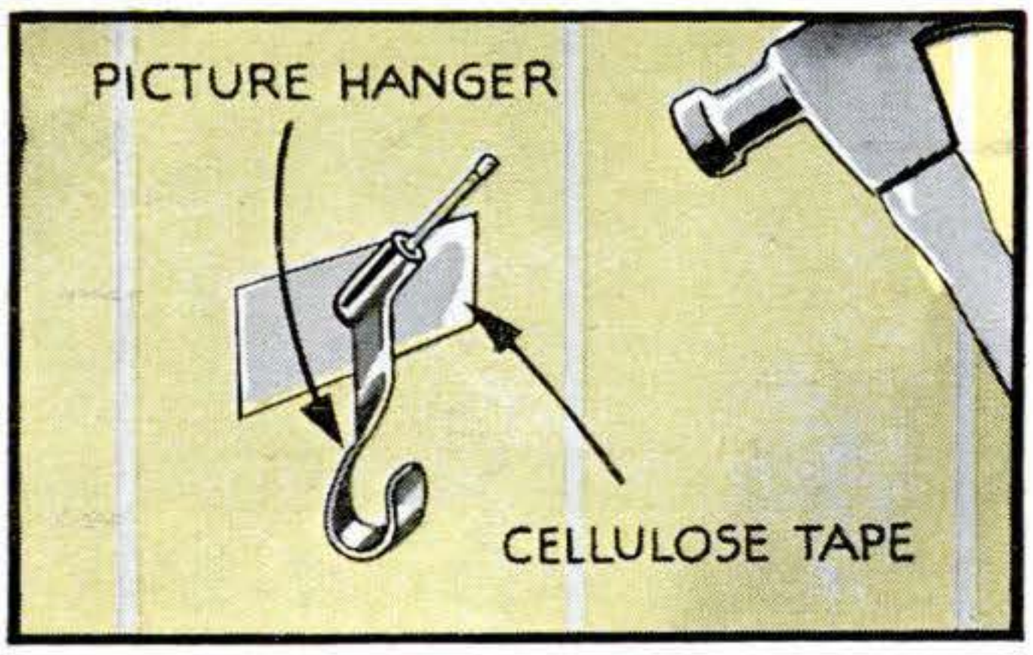


Excess grease on foods fried in deep fat will be absorbed by a clean paper sack if the food is put in it at once. Jiggling the sack helps and also spreads salt evenly on French-fried potatoes.

If a replacement part for your glass coffee maker fails to fit perfectly and provide a vacuum seal, a strip of rubber tape will enlarge the gasket. Rubber cement can be applied, but heat and use are usually sufficient for a good bond.



Plaster under picture hangers is sometimes marred when you drive in or remove a hanger. This can be avoided if a small strip of cellulose tape is first stuck to the wall to cover the area into which the nail is to be driven.



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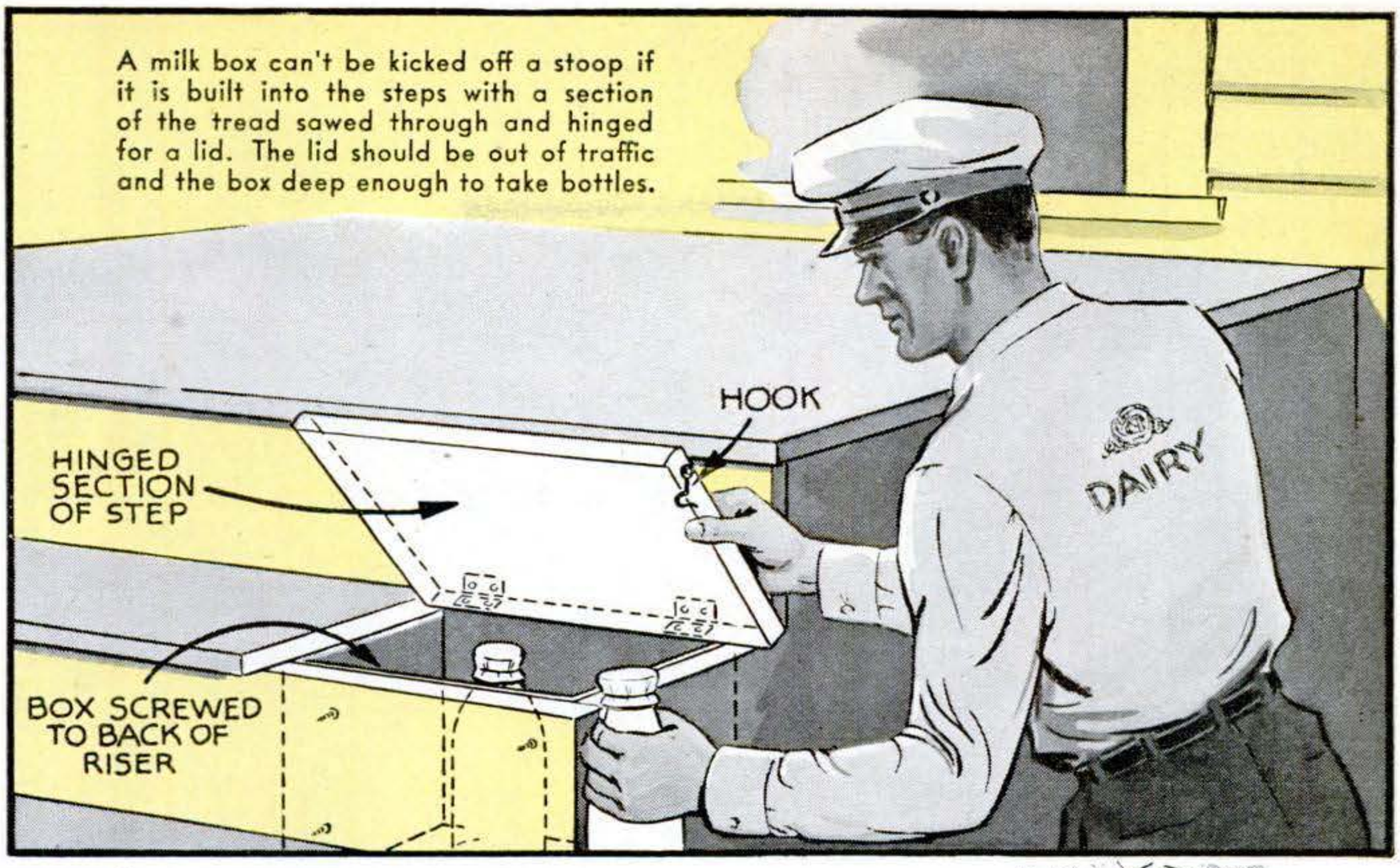
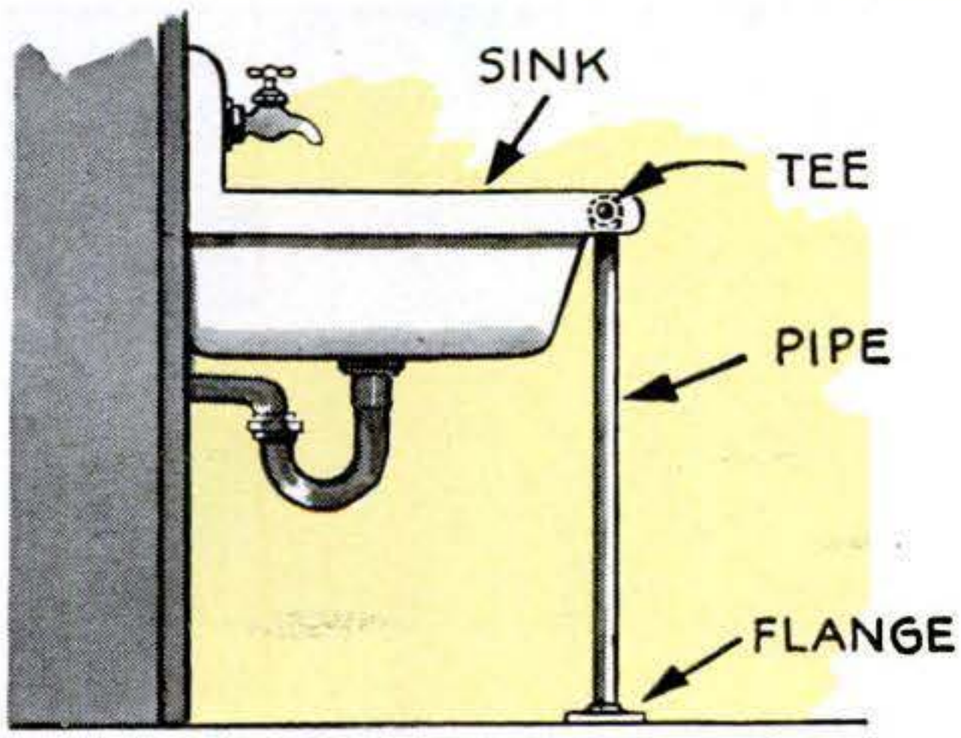
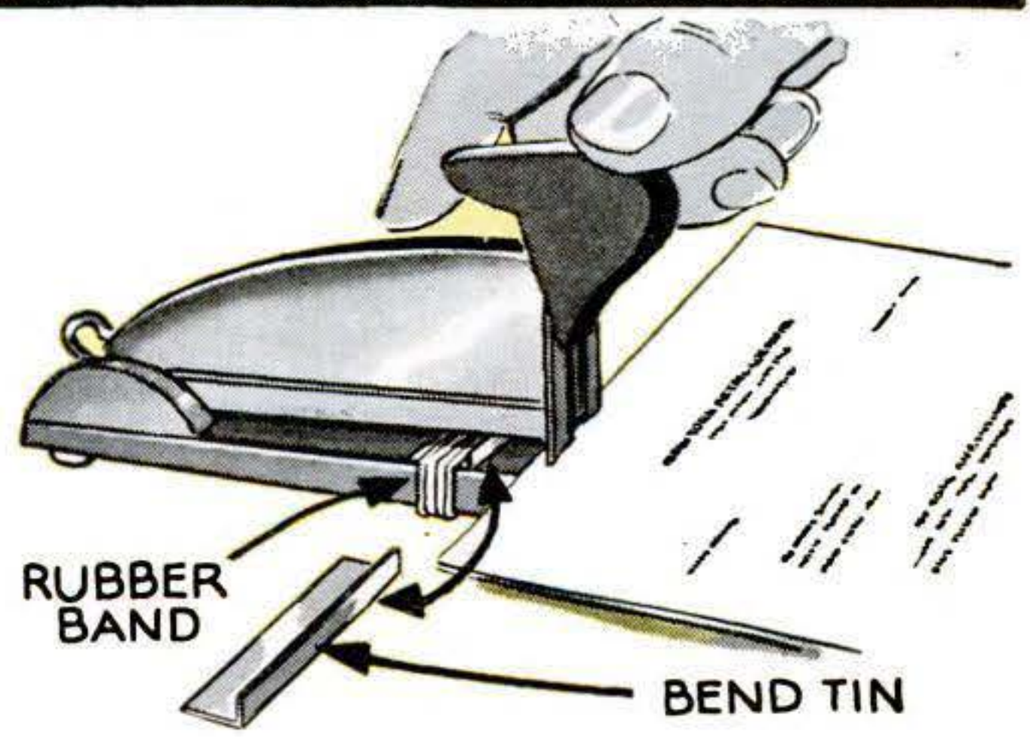


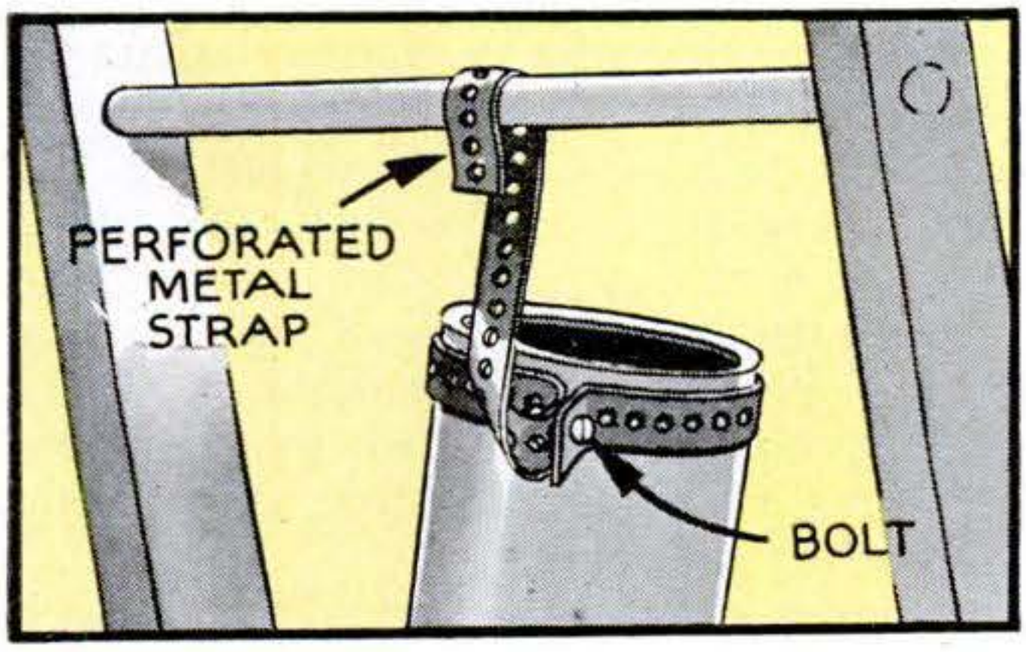


Hanging sinks that become loose at the wall joint can be supported readily at each front corner with ½" pipe. Fit the pipe under the apron with a tee. Fasten it at the other end with a floor flange.

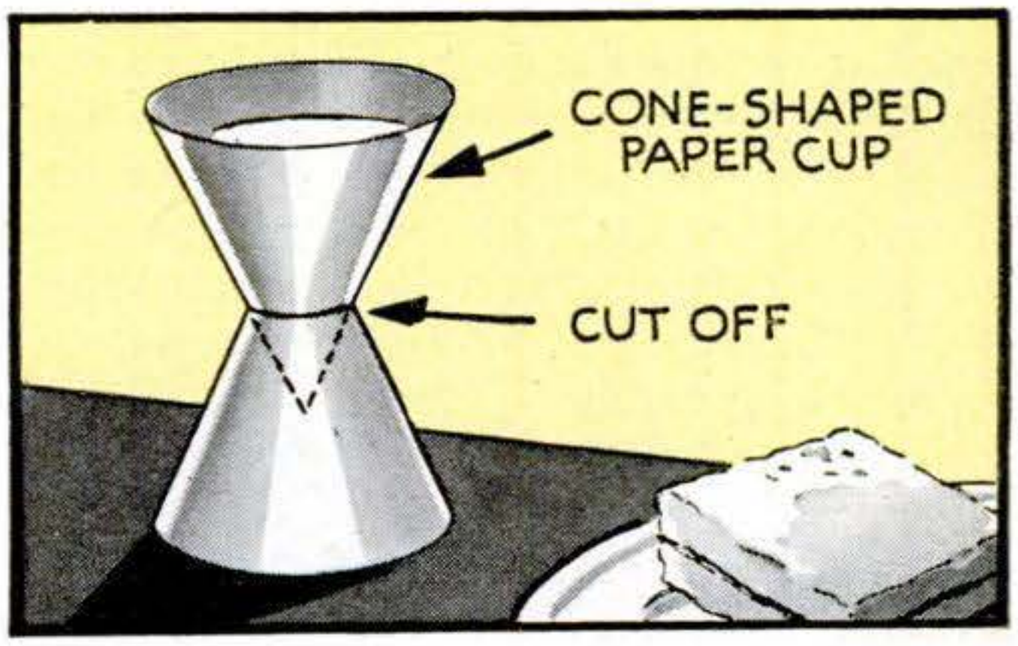


Uniform stapling margins are provided by a piece of tin-can stock flattened, bent upward, and held to the stapler base by a rubber band. The upright part serves as a stop for inserted papers.

When you need a hook by which a paint can may be hung on the rung of a ladder, loop a short length of plumber's perforated metal strap around the can and bind it tightly with a bolt and nut. Bend the free end of the strap into a simple hook.



Stands for cone-shaped paper cups can be made out of other cups from the package. Cut the pointed end off the cups that are to serve as stands and set them upside down on the table. The points of filled cups are merely placed in the open ends.



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FIZZ-WHIZZ

...A Midget Steam Car

By ROY L. CLOUGH, Jr.

MEASURING but 5″ in length, this tiny steam car chuffs along rapidly on any smooth surface. Doughnut-style model airplane tires give it a good grip on the "road"—whether concrete driveway, tennis court, or polished floor. Power is supplied by a ⅜″ by ⅝″ double-acting oscillating engine, while the crankshaft doubles as the rear axle. No flywheel is used, the car itself having sufficient momentum. An "ink-pad" burner fires the boiler and, unless oversupplied with alcohol, will not constitute a fire hazard. Caution: Don't operate Fizz-Whizz where it may run under furniture or into inflammable material.

Begin construction with the engine. The cylinder and piston are most conveniently made from a mating pair of ⅜″ fishing-rod ferrules. Use fine emery cloth and crocus cloth to polish the inner ferrule to a nice sliding fit in the cylinder. If you can't locate suitable ferrules, use ⅜″ brass tubing for the cylinder and a lathe-turned piston.

Note that the connecting rod is made in two pieces; the piston part is a length of 3/32″ tubing, centered in the ferrule and stiffened by a thin brass disk, and polished to slide nicely in a length of ⅛″ tubing. The latter, soldered to a disk that is subsequently soldered to the cylinder, forms the stuffing box. The other part of the connecting rod is a length of 1/16″ steel wire, formed in a loop at one end and filed at the other to fit within the tubular part.

Bend the crankshaft from 3/32″ wire, slip on the rear half of the connecting rod, and retain permanently with two small soldered washers. Tack-solder the two halves of the connecting rod together.

Lay out and drill the cylinder plate as in

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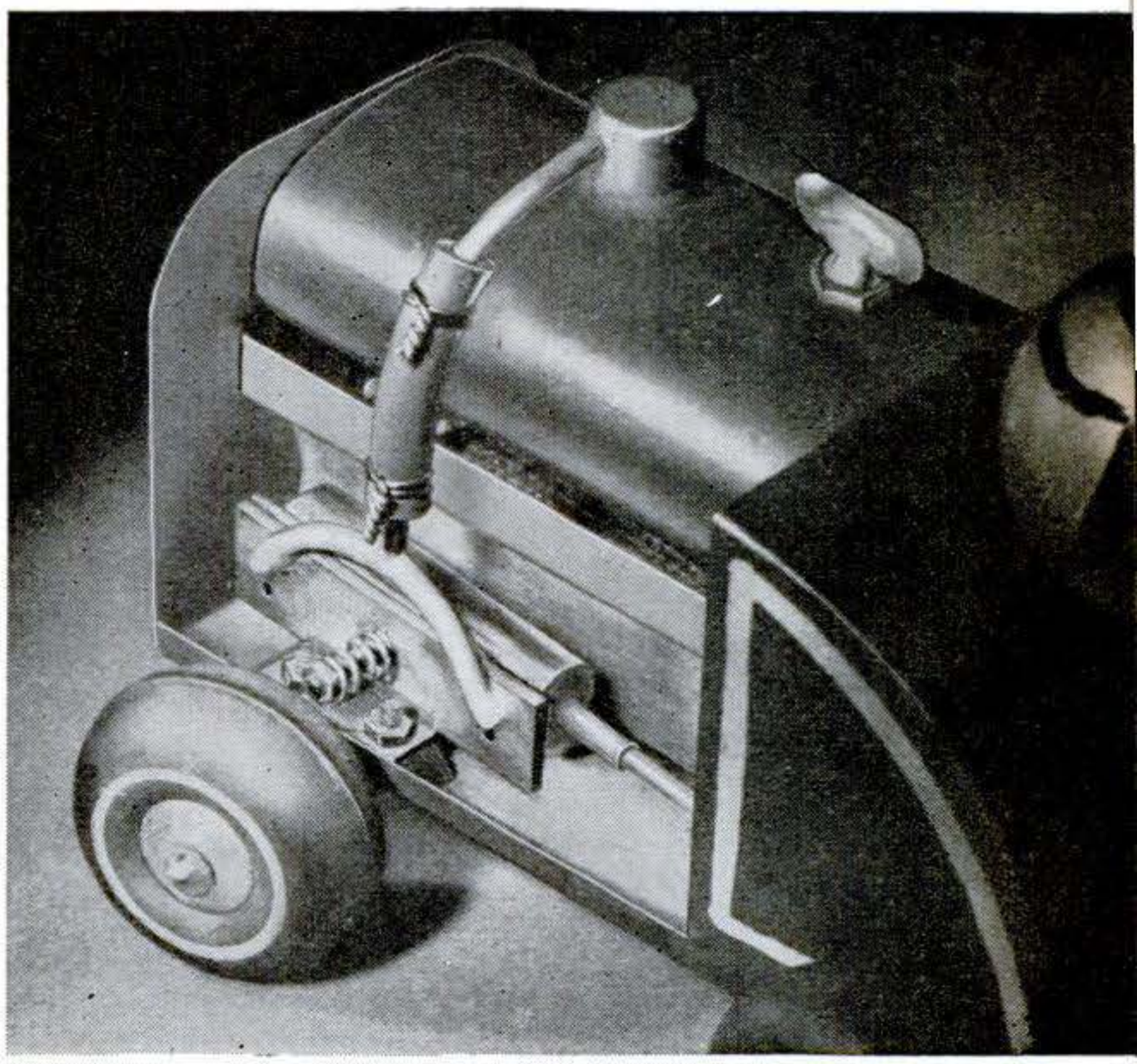
Fig. 1, making certain that the holes are aligned parallel to the sides. Tap the center hole 6-32, screw in a ½″ stud, and solder the plate to the cylinder. The steam ports are then drilled through the cylinder wall, as in Fig. 2. Cut out and bend the valve plate (Fig. 3) from 1/16″ brass. Bend the mounting lug with care in order not to impair the flatness of the face, and drill the mounting holes and a centered No. 29 hole for the pivot stud.

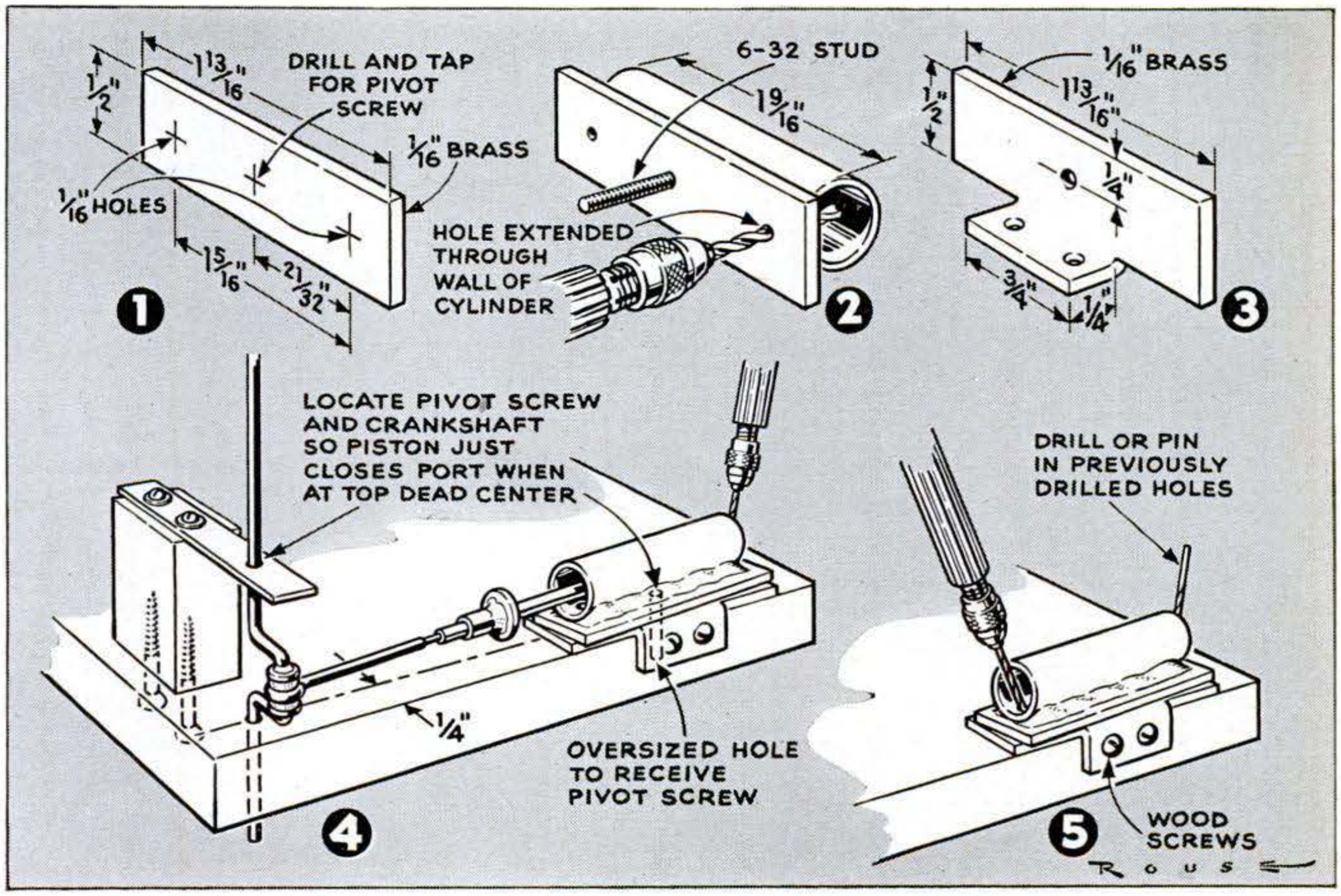
Assemble the uncompleted engine on a board as indicated in Fig. 4. A sheet-metal strip with a 3/32″ hole near one end is mounted over a similar hole drilled ¼″ from the edge of the board. Oversize holes for the screws holding this strip permit adjustment to get the crankshaft precisely vertical. The pivot screw on the cylinder fits in an oversize hole in the wood about 3½″ from the crank and ¼″ from the edge. Adjust the cylinder and valve plate so that the piston just closes the upper port at top dead center; then screw the plate to the board at that point.

Turn the crank 90 deg. (Fig. 4) and with a 1/16″ drill in the port in the upper end of the cylinder, turn the drill just enough to form a dimple in the valve plate beneath. Rotate the crank 180 deg. and make another dimple; then disassemble the engine and drill through the valve plate the two holes thus located.

To spot the other two ports, remove the piston and turn the cylinder on the valve



At right is a close-up of the single-cylinder engine that drives the little car. The series of steps below shows how the ports are located so the engine will have maximum efficiency.



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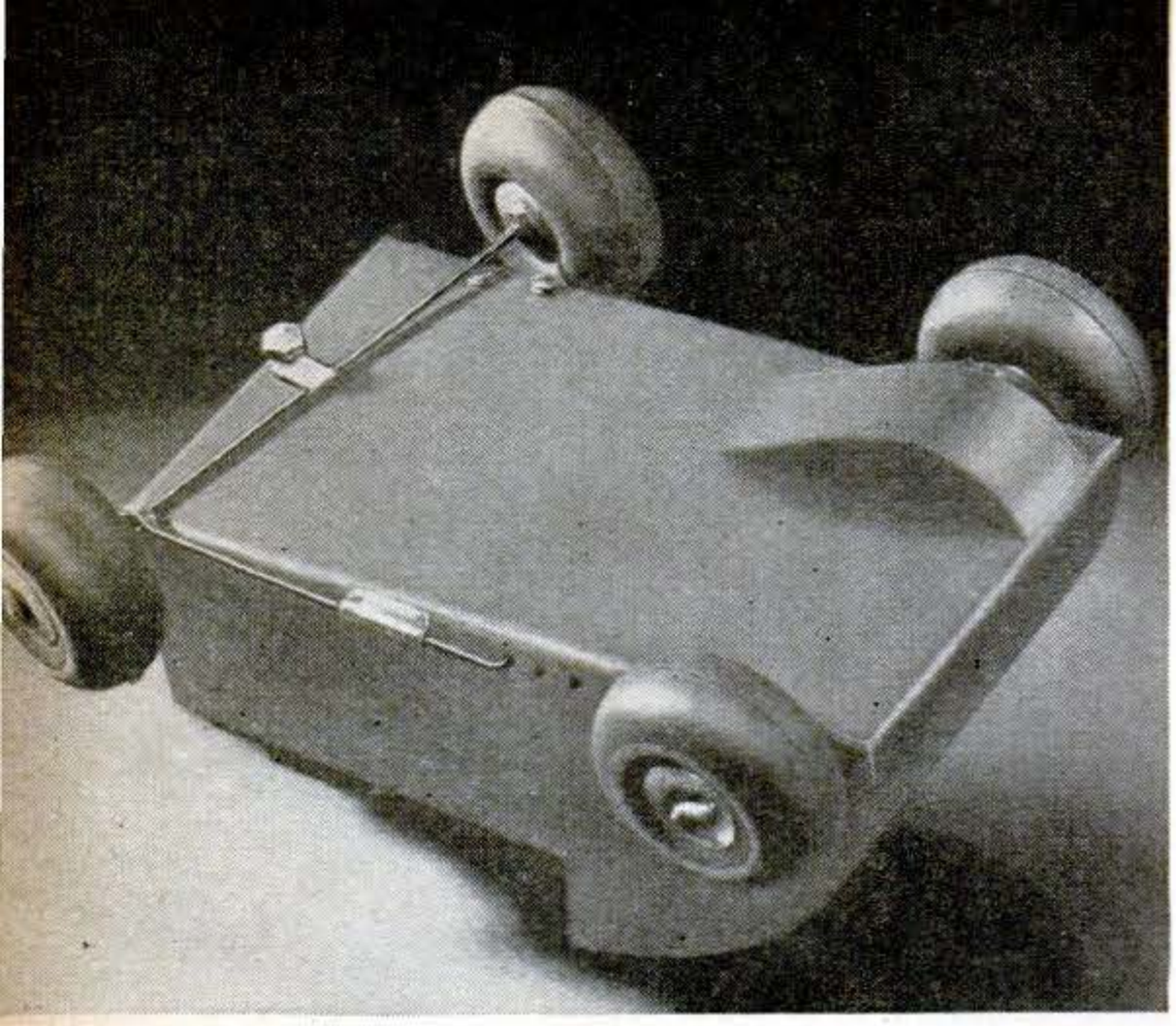
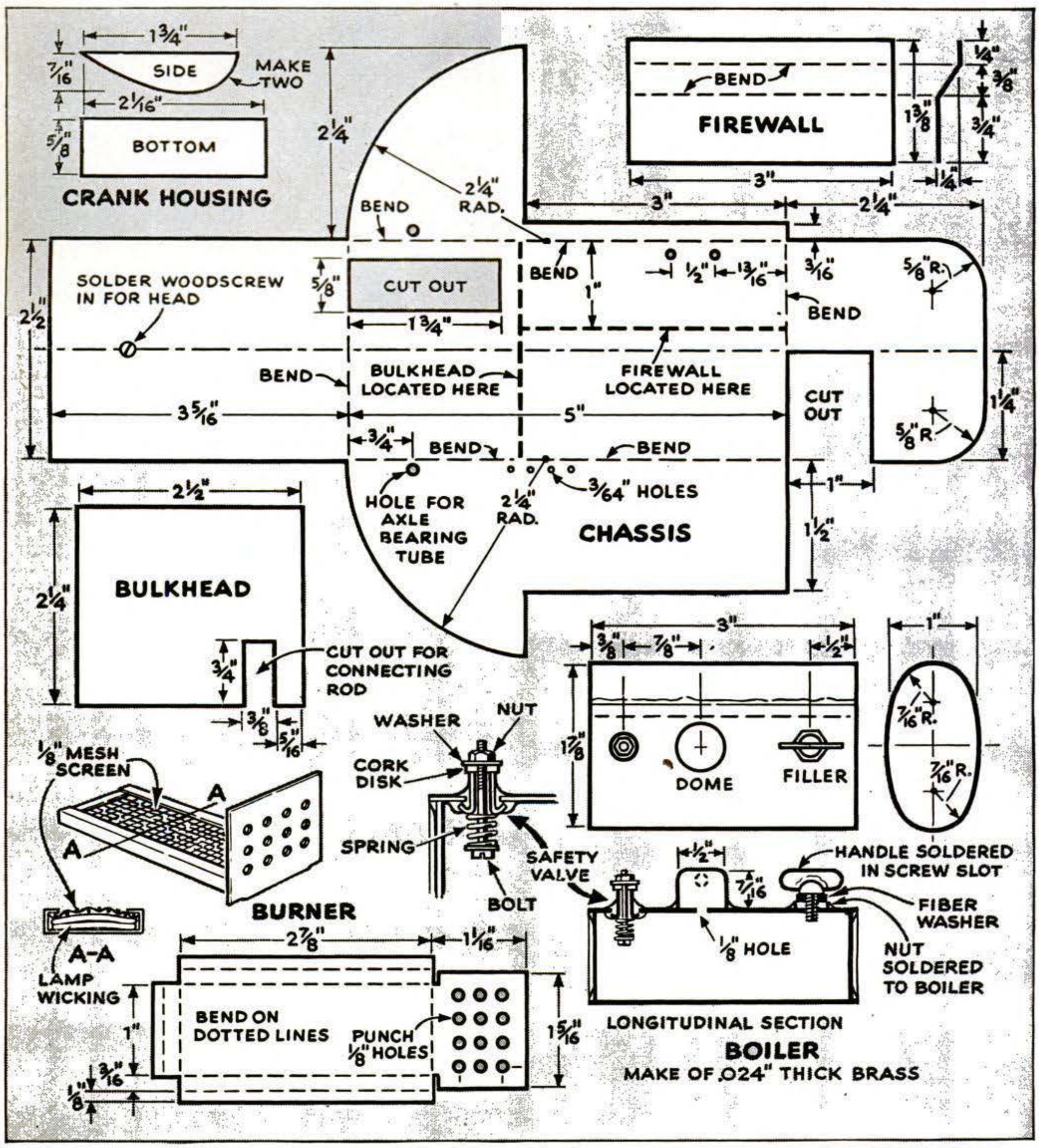


plate until the previously drilled holes line up. Push a close-fiting drill or pin through, (Fig. 5) while another port is dimpled at the opposite end. The pin is removed, the other port aligned, and the fourth port located.

Build up a steam manifold from ⅛" tubing and solder to the valve plate as shown in the photos. An easy way to do this is to peg the parts together with bits of wooden match-stick, flow on solder, and remove the pegs. Lap the valve and cylinder plates together with fine emery powder until smooth and

Note at left how a wire link around the front axle can be set in various holes to control the direction of the model.



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flat, clean well, solder in the cylinder ends, and assemble the engine with a light spring and a 6-32 nut.

Use tin-can metal for the chassis and bulkhead. Make a cardboard pattern to the exact dimensions shown and trace around it on the tin plate with a scriber. Cut out, bend the chassis to shape, and solder together, but leave the back flap open until you are ready for final assembly.

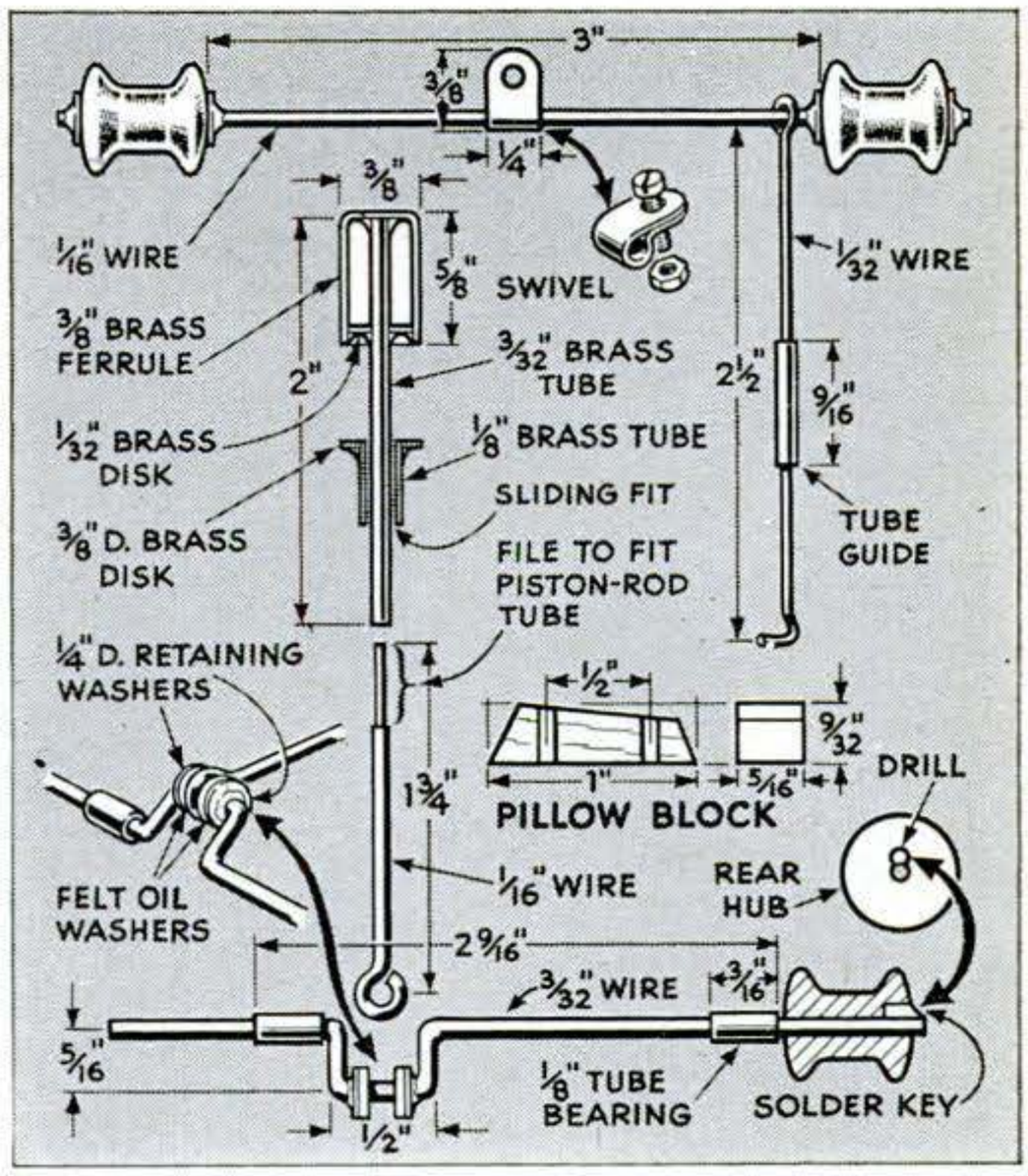
The burner is simply a piece of tin plate folded over to hold some wicking and a piece of screen. Make the boiler from .024″ sheet brass curved to an elliptical section and fitted with two ends. For maximum strength, use a few rivets as well as solder on the longitudinal seam. Tack-solder the ends in place, flange over the edges of the shell with hammer taps, and fill the recesses thus formed with solder. For a steam dome, cut a ½″ length of ½″ tubing, solder on an end cap and steam line, and solder the dome over a ⅛″ hole in the top of the boiler. As a filler cap, solder on a nut and use a wing screw and washer. Though not used on the model pictured, a safety valve is desirable. Solder on a short length of ⅛″ tubing near the front of the boiler, and fit it with a spring-loaded bolt to hold a disk of soft automobile gasket material against the upper edge.

For a front axle, use 1/16″ steel wire passing through a swivel clamp. The steering link is a piece of wire looped around the axle and run back through a tubular guide. A row of holes in the chassis to take the bent end of this wire permits adjustment. The wheels, obtainable in a model-airplane shop, shouldn't exceed 1⅜″ in diameter for best performance. Retain the front ones on the axle by four small soldered washers.

To assemble Fizz-Whizz, insert the engine with the bearings on the crankshaft and solder the bearings to the inside chassis floor. Mount the engine on a wooden pillow block and shim it carefully to insure equal steam intake on both strokes. Adjust the two-part connecting rod for correct piston travel and solder it permanently together. Hold the boiler in place with a drop of solder at each end, and use neoprene tubing to couple the steam line. "Key" the rear wheels to the axle by means of little lugs of solder adhering to the steel axle and fitting into drilled recesses in the aluminum hubs. Be sure to remove the rubber tires during soldering.

Attach a painted wood ball to simulate the driver, using a wood screw, and solder the back in place. Fill the boiler about half full,

After a run the fuel supply can be replenished by a few squirts of a medicine dropper—but be sure the flame is out. Never let the boiler run dry.



Two oil-soaked felt washers on the crankshaft next to the connecting rod will aid in its lubrication.

squirt about six medicine droppers of alcohol on the burner pad, light, and slide into place. Block up the model so that the rear wheels clear the table and turn them a few times after the boiler has begun to steam to clear the engine of condensate. Then adjust the tie rod for a circle, place Fizz-Whizz on the floor, and give it a gentle push. END

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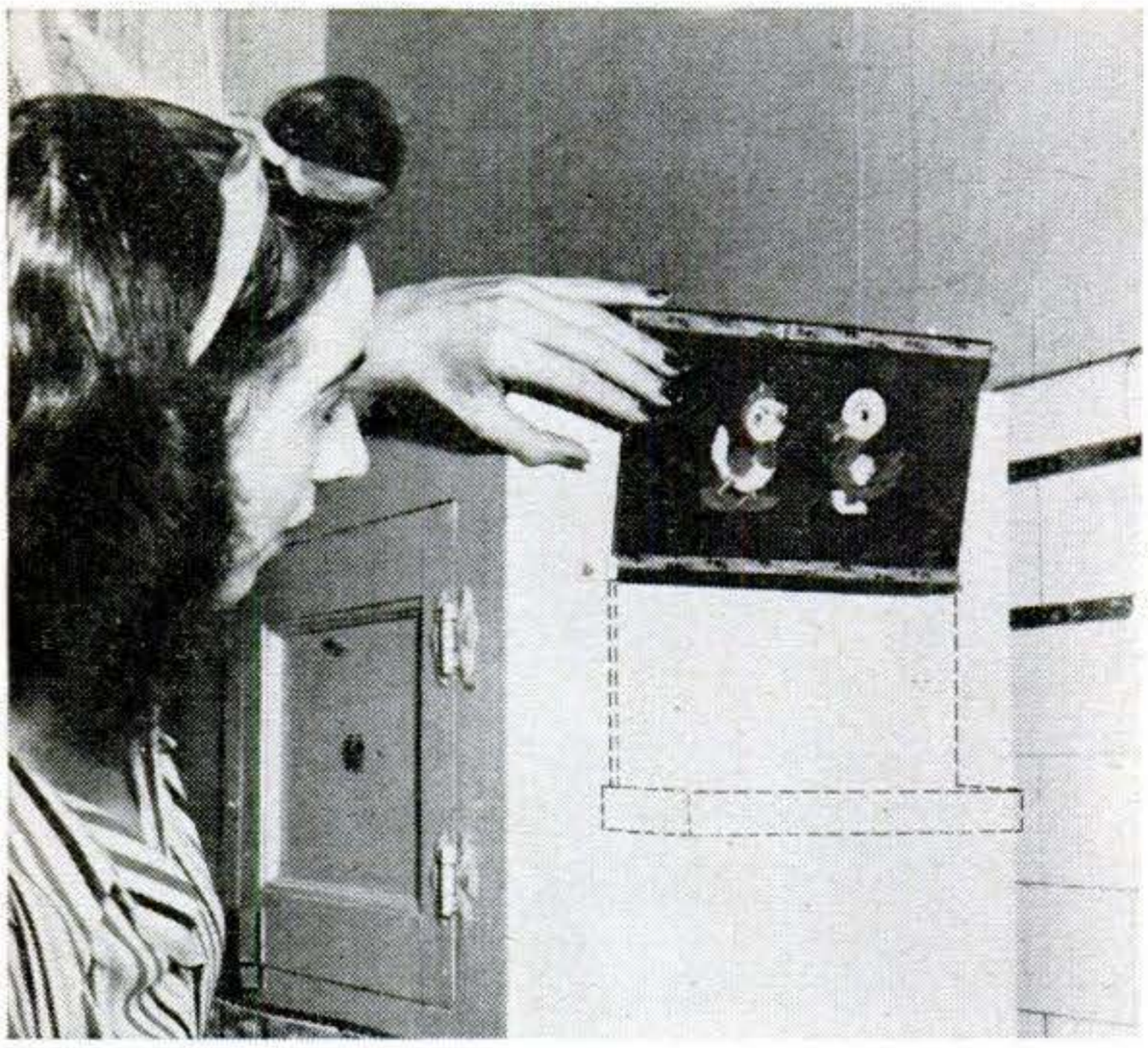
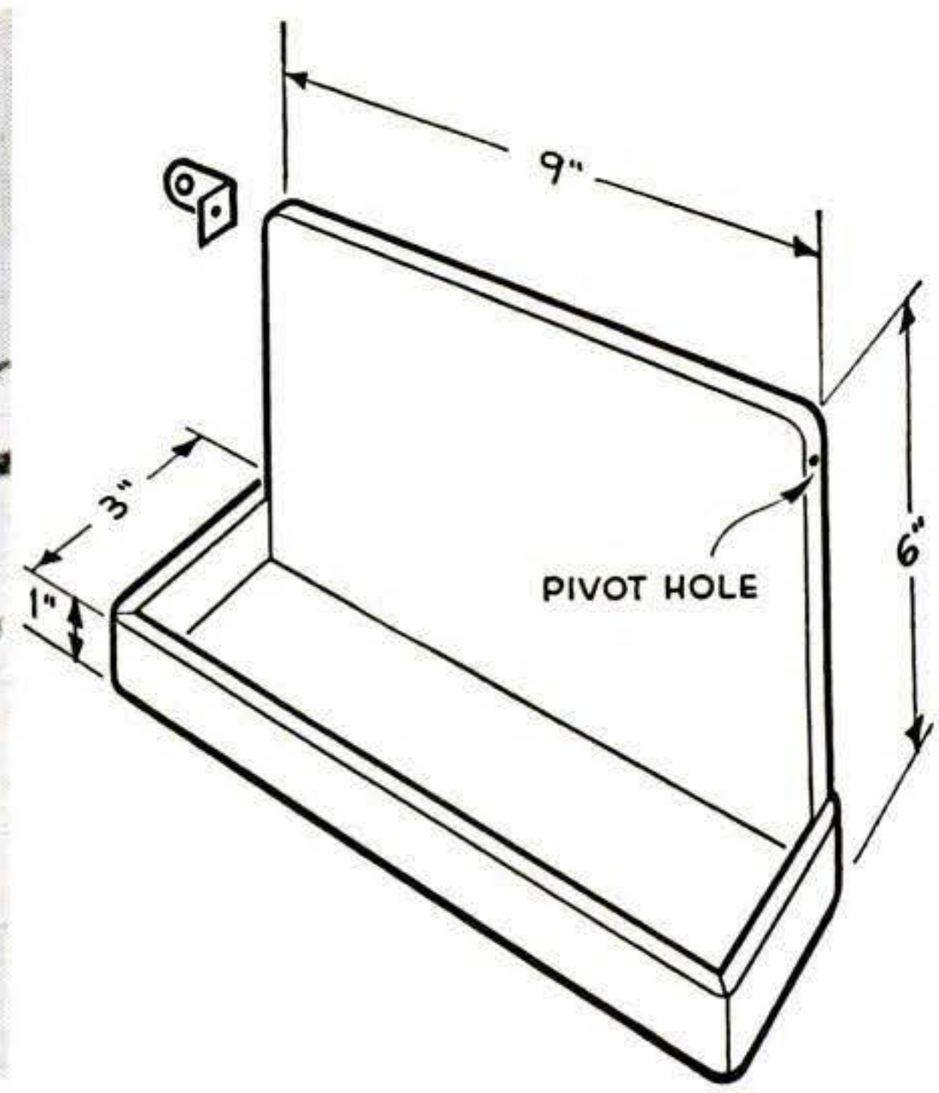
Decorated Spice Shelf Folds Upward to Become Wall Plaque

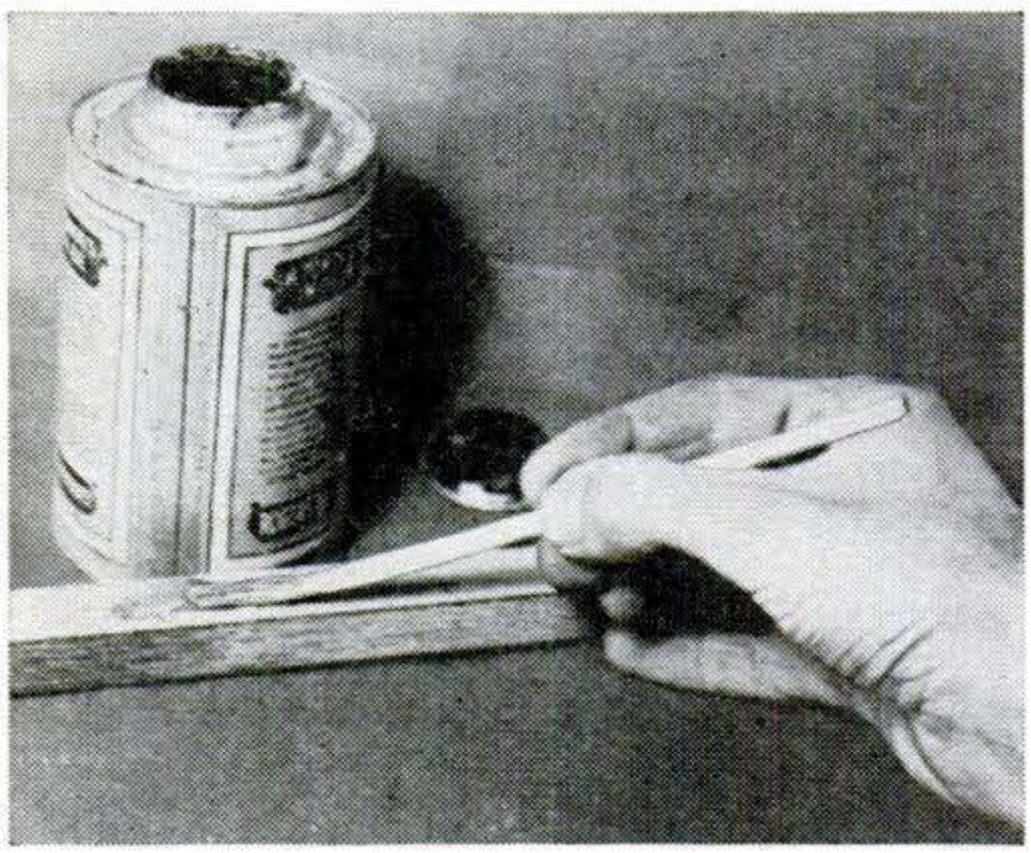




MOUNTED on the side of a kitchen cupboard, this handy occasional shelf will hold spices. When not in use it can be flipped upward to serve as a decorative plaque.

Make the piece of ¼" solid stock or plywood and hinge with long brads and small angle brackets. Dress the top edge to permit a 180-deg. swing and glue a small strip to the back of the bottom edge so the shelf will rest level against the cupboard side. Hang in the up position with the shelf part laid on the top of the cupboard to be sure it will clear when flipped upward.

The decal transfer is, of course, put on the back upside down to be right side up when the shelf is turned.



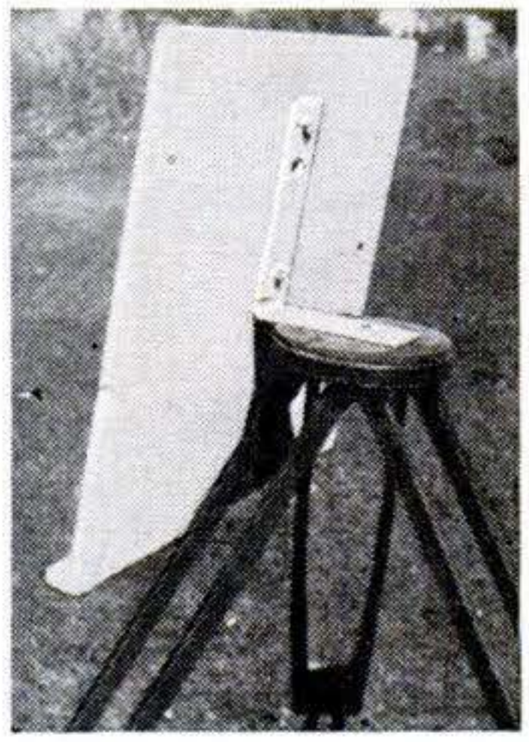
Hickory Slivers Spread Glue

SPLIT into thin strips, old hammer handles and other pieces of hickory make excellent glue spreaders, paint stirrers, and the like. They are flexible and strong and do not break easily even when dressed by sanding to almost paper thinness. A ¼" by ½" width and 4" to 6" length will be convenient for spreaders. Stirrers are larger.

Tripod Forms Portable Easel

FOR the photographer who also sketches and paints, a board and bracket will convert his camera tripod to a convenient easel. No alteration of the tripod is involved, and it can serve both for picture-taking and picture-painting on the same artistic jaunt.

Make up a 12" by 14" drawing board of ¼" inch plywood, and glue and nail a ½" lip on the bottom to hold the work. The board is mounted on the tripod by means of a length of 3/16" by 1¼" strap iron bent to an angle and drilled and tapped ¼"-20 for the tripod-head screw thread. Bolt the strap-iron mount to the board, countersinking the bolt heads in the face. Fill the holes with wood putty and sand smooth.



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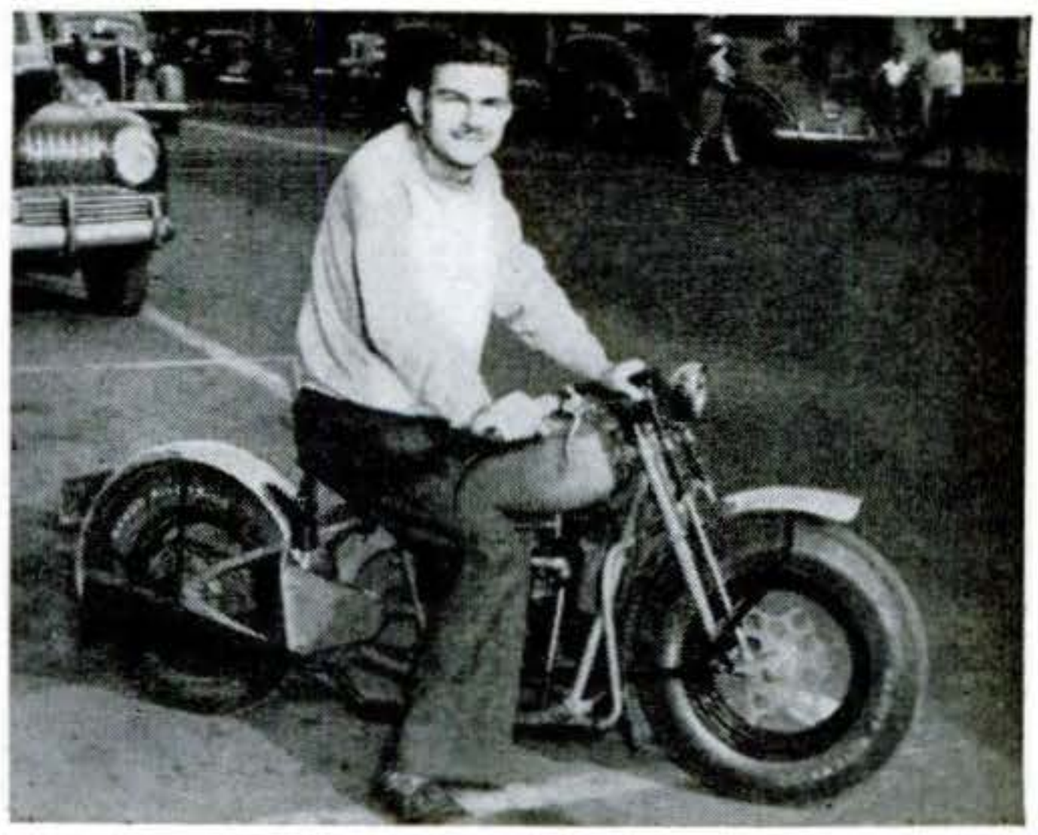
CRAFTSMEN at WORK

BATTLE IN THE PHILIPPINES. This 14″ by 18″ model of a U.S.-Jap engagement is the work of two young Filipinos now living in Brooklyn. German Yrisarry, 16, and his brother Mario, 13, used cardboard for the bodies of the 1″ figures, wire for legs, balsa for feet, and rolled paper for arms. Helmets were made from small native beans. The armored half-track is cardboard with rolled-paper wheels. Bits of wood, twigs, dyed cotton, and hemp finish a plaster terrain.

A PRIZE WINNER. B. J. Lane, of Regina, Sask., built this 12′ sailboat from a set of plans published some years ago in PSM. With a sister ship built from the same plans, she ruled Labor Day regattas for three years, and the two have consistently beaten craft of their own size and 14′ boats, too. There are no boats on the lake, Lane writes, so well balanced and easily maneuvered as these two homemade ones.



40-M.P.H. MIDGET. In spare time in a home workshop, Cleatus Clobes, of Decatur, Ill., built this little machine from the ground up. It is powered by a 1.8-hp. motor, has full ball bearings, and is equipped with midget racing-car tires. A two-speed gear shift makes its performance on the road exceptionally flexible.

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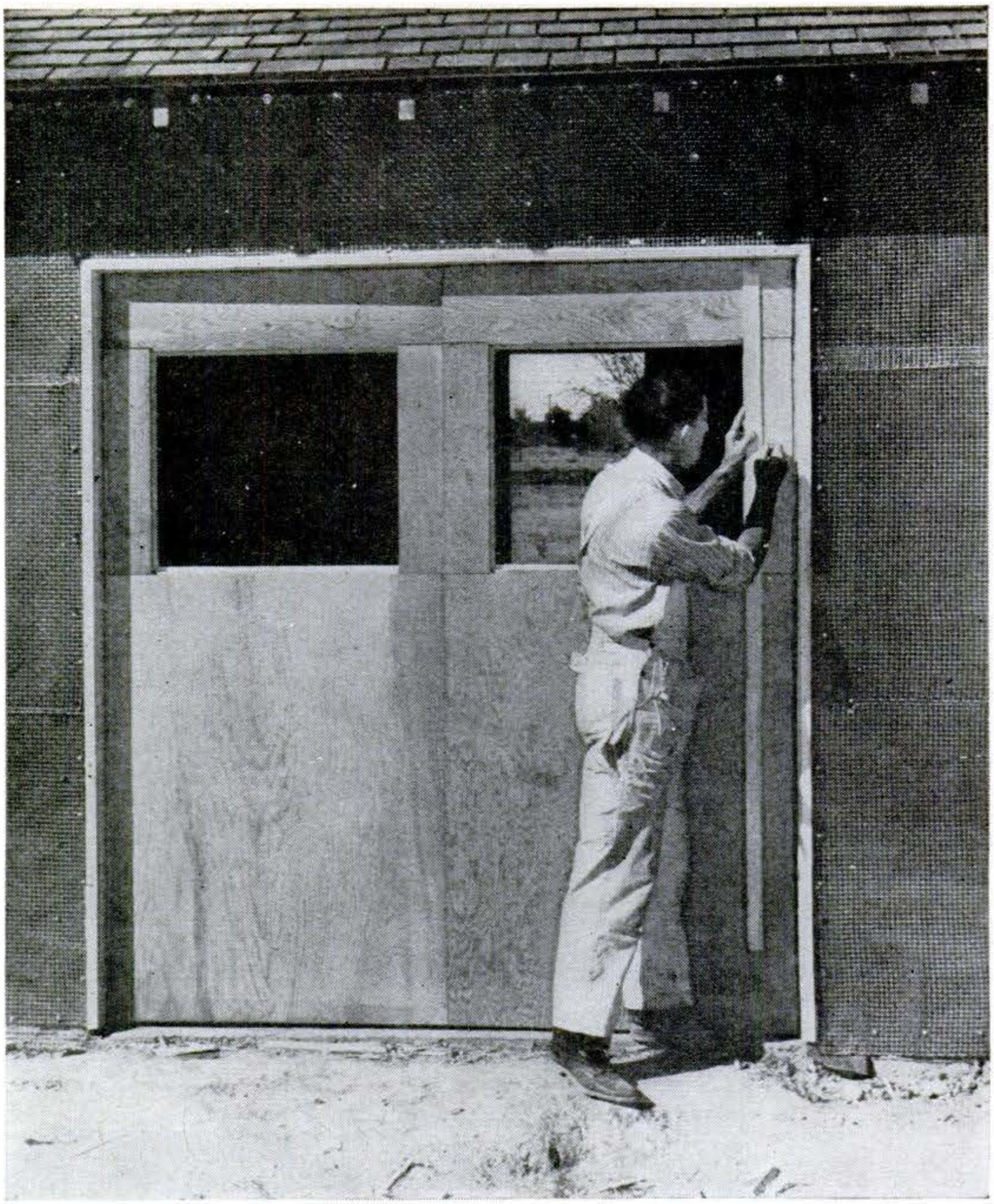

Plywood-sheathed doors take many styles of trim. Here a pair are being marked for horizontal strips or battens. The openings are for removable sashes for use in winter and for screens in the summer.

Home-Built DOORS for Special

HOUSE doors are usually purchased from a mill, but garage doors and special doors such as for a shop are often built on the job. Double rabbet-edge doors suitable for a home or farm workshop are shown in Fig. 1 and in the photos above and on the facing page. Although sheathed with plywood, they are trimmed with ¼″ by 1½″ strips or battens to match an overhead garage door planned for the same building. An opening is provided in each door to receive a lightly framed screen for summer and a sash for winter.

The door frame is built of 2″ by 6″ lumber (1½″ by 5½″ net) and joined with double mortise-and-tenon joints. Sheathing may be ¼″ three-ply stock, preferably waterproof. The locking stiles are planned to show the same width outside, as indicated in Fig. 1. This will require adding a strip for a sash stop instead of rabbeting one side of the window of one door. Its rails will also

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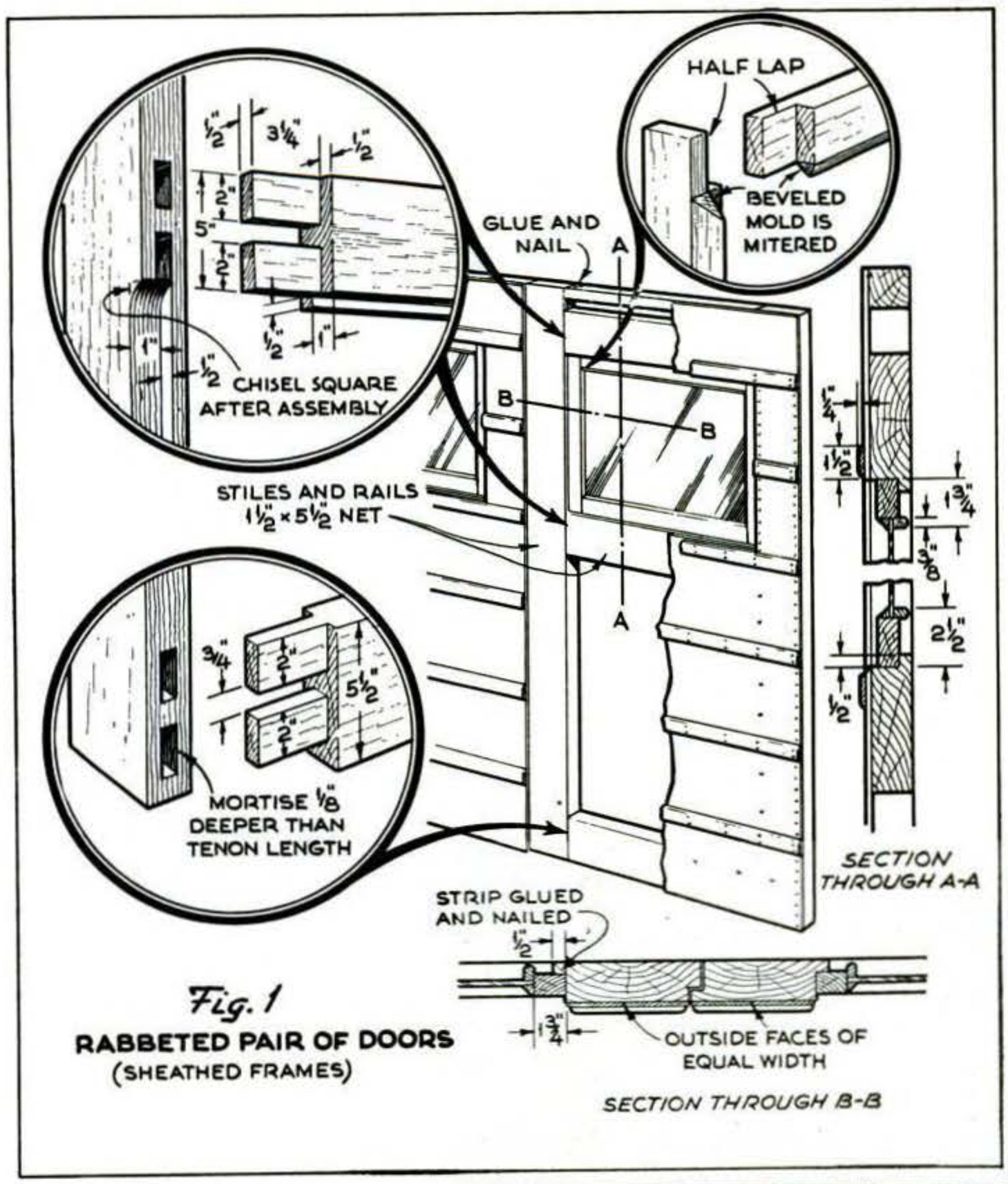
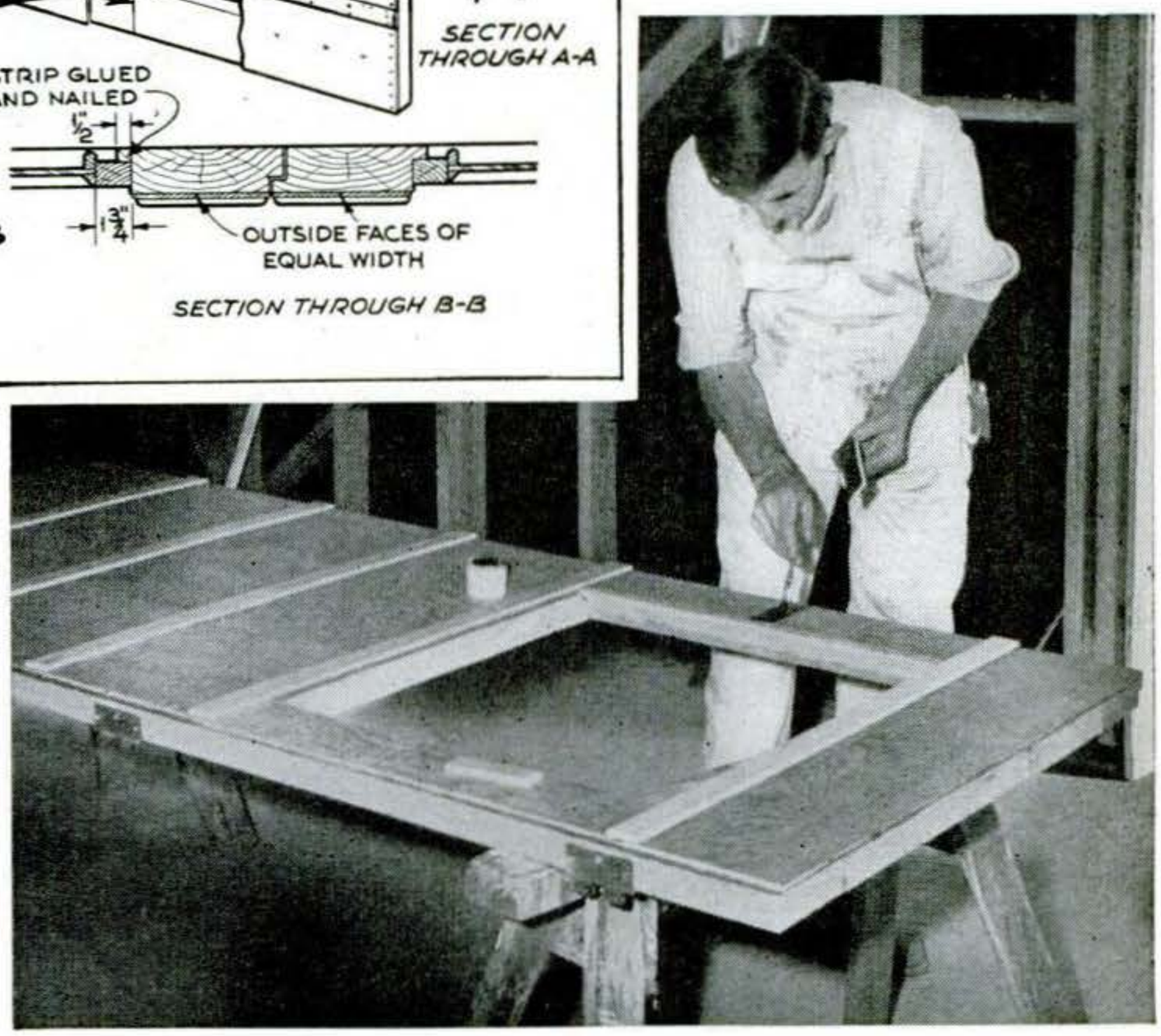


Fig. 1
RABBETED PAIR OF DOORS
(SHEATHED FRAMES)

Doors in pairs take rabbets at the lock stiles, which must be planned to show equal widths on the outside. This requires a strip instead of a rabbet for one window stop. Heavy lumber in frames assures sturdiness.

Plywood may be roughly pieced for the sheathing when battens are used, but a single sheet must be prepared carefully for each door if the surface is to be plain. Use waterproof glue at all exposed edges. Brads and glue hold the battens.



By
EDWIN M. LOVE

•

Purposes

be correspondingly longer. Stop-rabbet the window frame of the mating door with a shaper or jointer, and chisel out the corners after assembly. Location of the rails above and below the window openings is determined by the spacing of battens, which should frame the window at both top and bottom.

Fit and hang the doors before adding the plywood sheathing. This may be roughly pieced if battens are used, but a single sheet should be prepared for each door or the joints fitted accurately if the surface is to be plain. Lay a door on sawhorses to put on the plywood, apply heavy casein glue along the inner edges of the stiles and rails and along the centers, and apply a ribbon of waterproof plastic glue along the edges that will be exposed to weather.

Rehang the doors to mark the positions of the battens with a pattern stick butted against the upper jamb. The spacing, of

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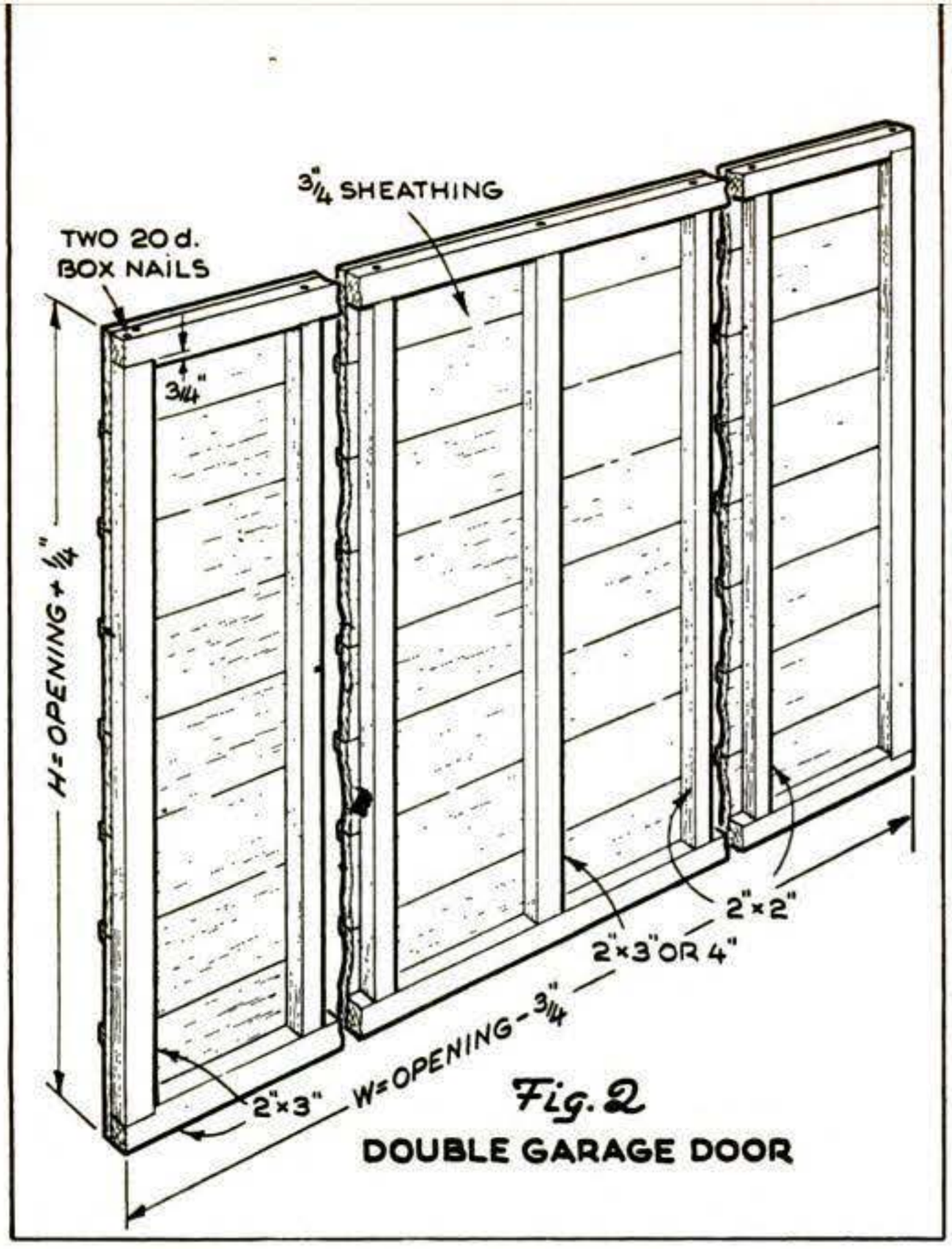
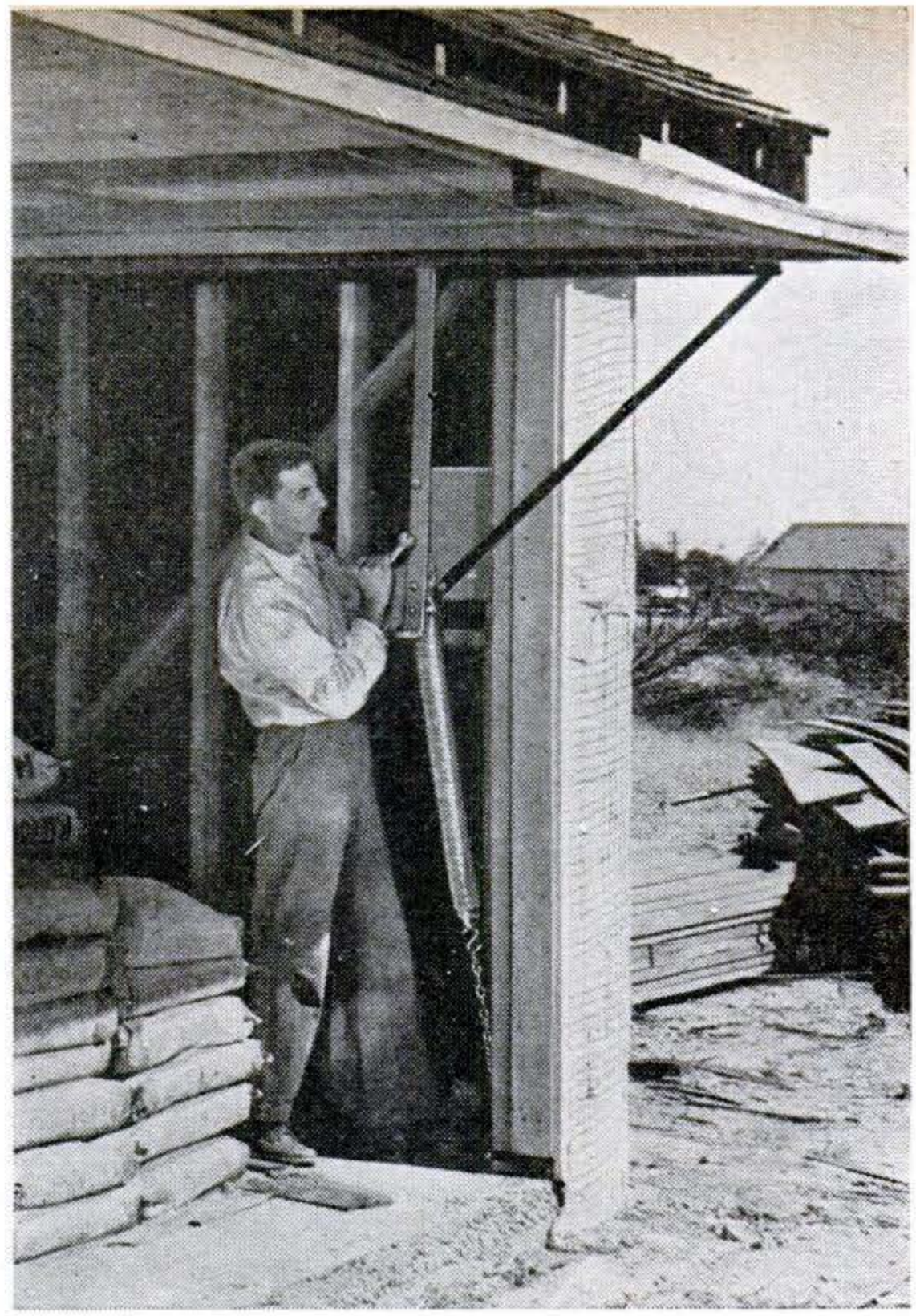


Fig. 2
DOUBLE GARAGE DOOR



Outer members are nailed up and squared first for the frame of a garage door; then the center stiles are butted in and the sheathing applied. This is a double-width door. Only one 2" by 2" is needed between center and side stiles for a single door. At right, bolting a kicker on for easy starting.

course, is taken from the garage door, the position of battens being fixed by the horizontal joints in the board sheathing. For best results, it is advisable to take the doors back down again and lay them on sawhorses for attaching the battens with waterproof glue and brads.

Make the screen and sash frames of 1″ stock with half-lapped corners glued and nailed. The fit should not be so snug that they cannot be easily removed.

Garage doors, being bulky, are usually built on the garage floor or on the ground near by. Make the outside frame first of 2″ by 3″ or 4″ stiles and rails, notching the side stiles into the rails and nailing the joints with two 20d. box nails; then butt a center stile of the same stock between the rails. In addition, a single-width door will need a 2″ by 2″ stile midway between the side and center stiles, and a door of double width will need two such 2″ by 2″ stiles in each space, as shown in Fig. 2. Square the assembly and nail the joints.

Coverings for such doors are usually siding, pattern lumber, or plain boards having their joints hidden by battens or moldings, and the boards may run horizontally or vertically. Lay the boards on sawhorses, square one end of each, and mark to length with a pattern; then nail the boards while the door is lying flat, starting at the bottom. Well-seasoned lumber should be primed beforehand and allowed to dry, and the edges of the joints should be painted again as assembly proceeds. If poorly seasoned lumber must be used, it is best to let the assembly dry out as long as possible before applying any paint. Battens will make even a green door windtight when nailed only at one edge to allow for shrinkage without splitting. Tacking instead of nailing will permit pulling off the battens for painting their backs when seasoning is more complete.

Double-width doors are trussed with a steel ribbon at top and bottom (Fig. 3) to reduce sagging when they are raised. If the tape is not attached to the anchor bracket, feed it through the slot about 3″ and fold it back on itself for locking. Nail the center truss brackets in place before tightening the steel tape.

Two popular types of overhead garage doors swing up with a slight lift on a handle, pivoting on wall brackets with counterbalancing springs extending along the walls, or hinging on double arms with springs mounted on the jambs. A typical installation of the latter kind is shown in the photos above and in Fig. 3. Nail the stops to the jambs near

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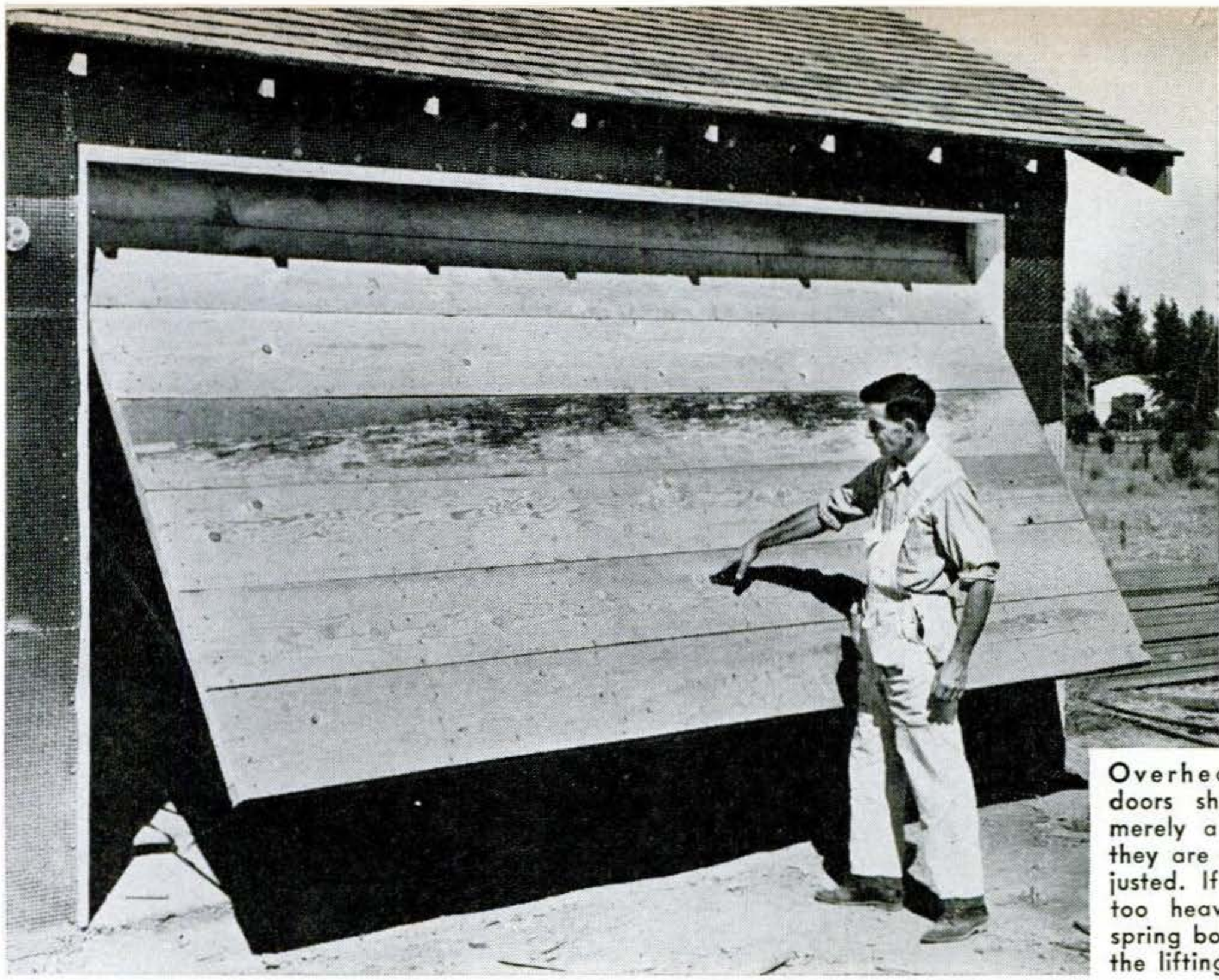

Overhead garage doors should lift at merely a touch when they are properly adjusted. If one appears too heavy, shift the spring bolt up. Below, the lifting mechanism.

the bottom, place ⅜″ blocks on the floor, and stand the door on them, wedging the edges to even jamb clearance. Screw the pivot brackets to the jambs flush with the faces and attach the angle irons to the door with lag screws through the ends.

Next, hang the springs and secure the chains with lag screws 4″ above the floor or at a height that will cause the springs to be stretched 3″ or 4″ when they are hooked to the chains. Stretch the springs by prying a crowbar against blocks nailed to the trimmers. Adjust the secondary pivots in their slots with the door properly centered and held back against the stops.

Bolt on the handle at a convenient height and test the action. If the door is too heavy, shift the spring bolt a hole or two nearer the end of the lever or, if it is too light, shift the bolt toward the pivot. Kickers are bolted on for double doors. They are irons that bend the springs sidewise near the top and give an extra nudge to start the door on its way up.

Shed doors made simply by nailing vertical boards to cleats should be braced with a diagonal running from the hinge edge at the lower cleat to the locking edge at the upper cleat. Clinch nails along the grain to sink the points. Battens or roofing paper will keep out rain. END

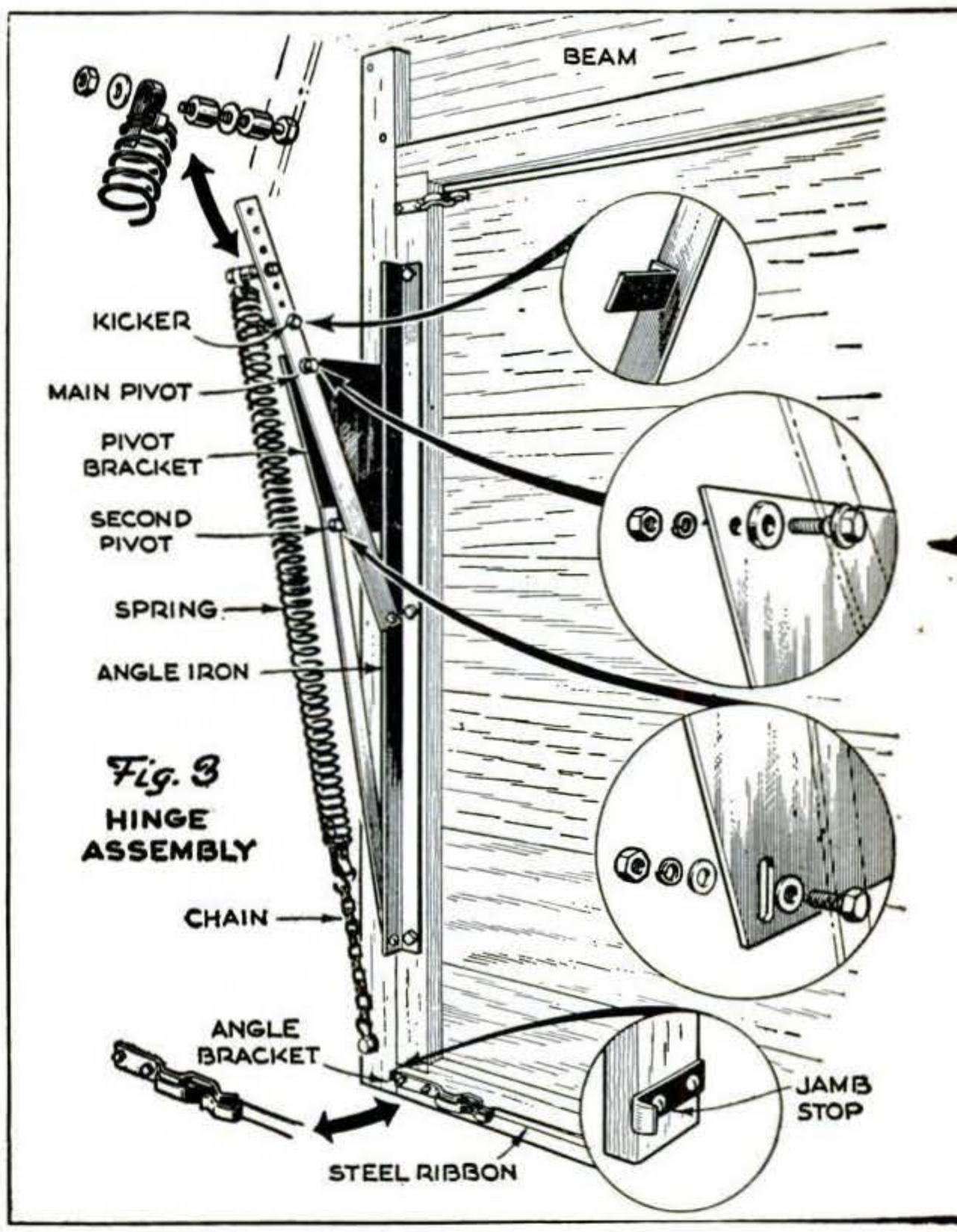

Fig. 3 HINGE ASSEMBLY

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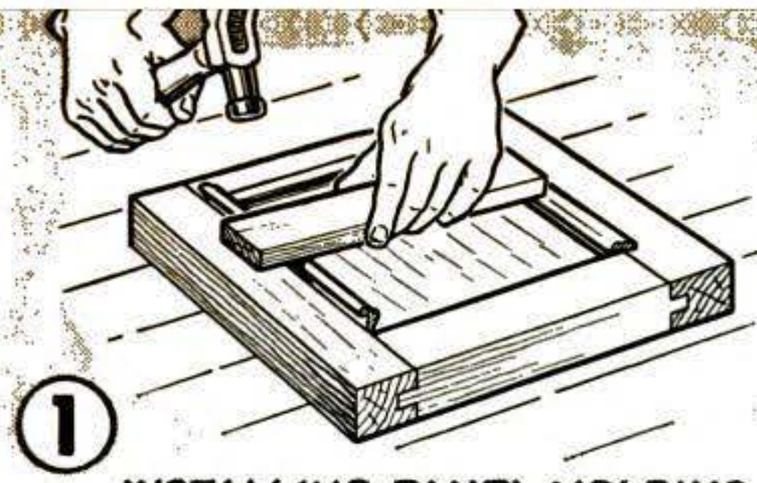
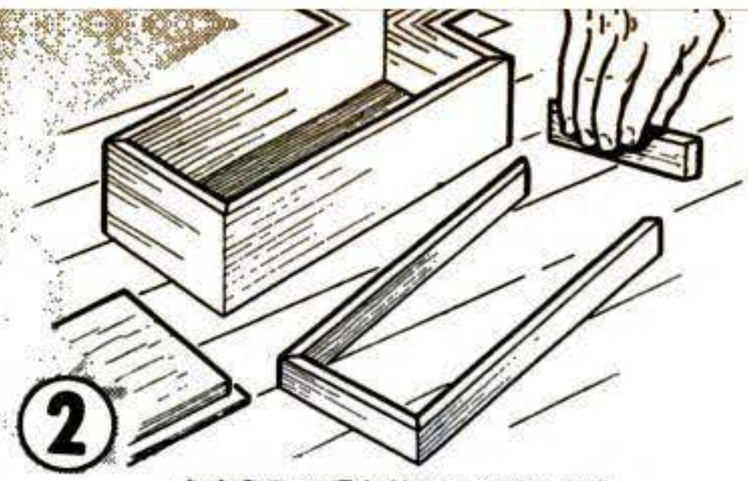
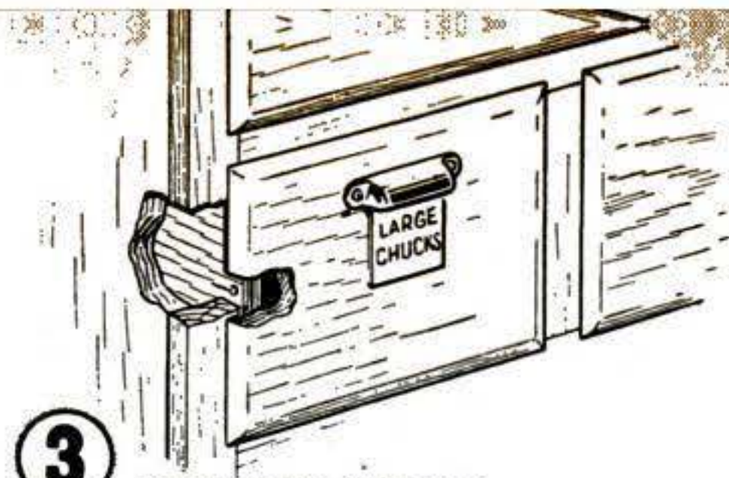


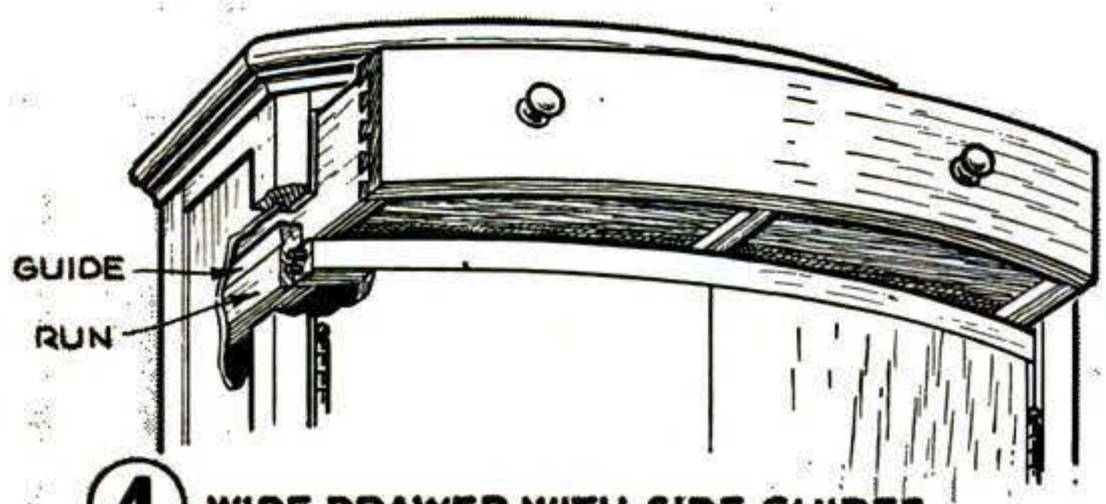
1 INSTALLING PANEL MOLDING



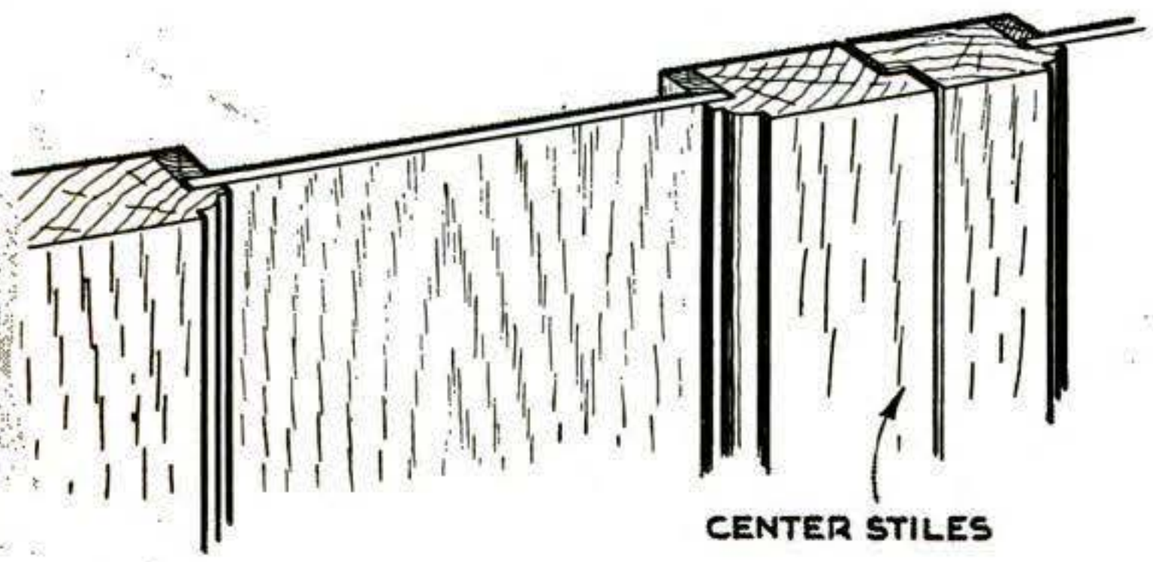
2 ASSEMBLING LID OF SMALL BOX



3 DRAWER FRONT STOPPED AGAINST STILE



4 WIDE DRAWER WITH SIDE GUIDES



5 PAIR OF CABINET DOORS

What's Wrong?

FIVE woodworking errors are shown here. Can you find them? The answers are given upside down below.

ANSWERS

1. All four moldings should be forced in at the same time.

2. For accurate fit, the entire box should be assembled as a unit and the lid then sawed off.

3. When the lip is used to stop a heavy drawer, the front is likely to split. A stop at the back is much better.

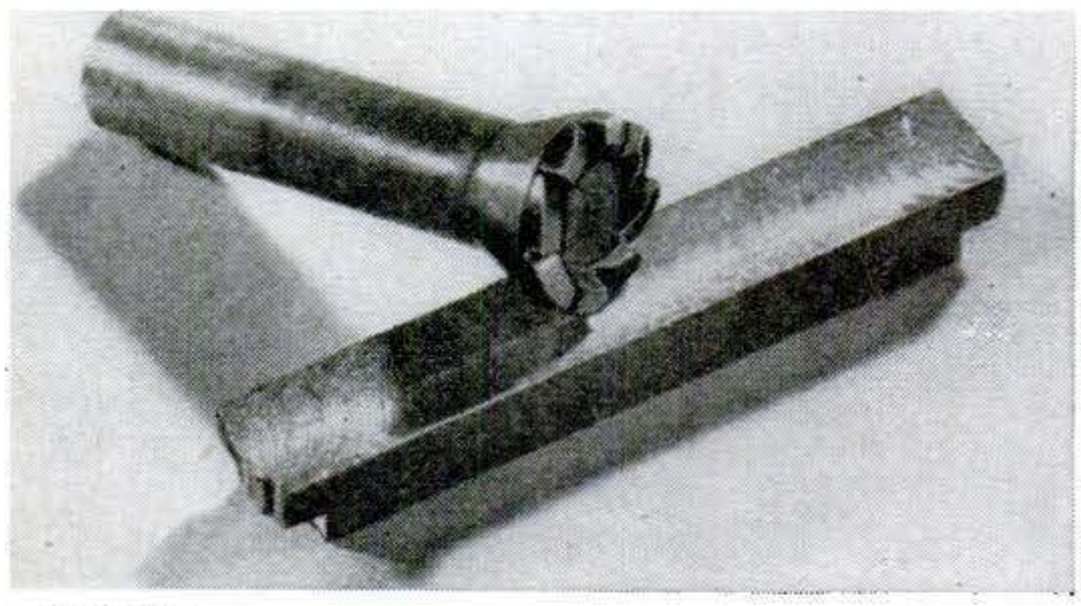
4. Wide drawers that are shallow from front to rear jam on side guides. A center guide provides clearance on both sides.

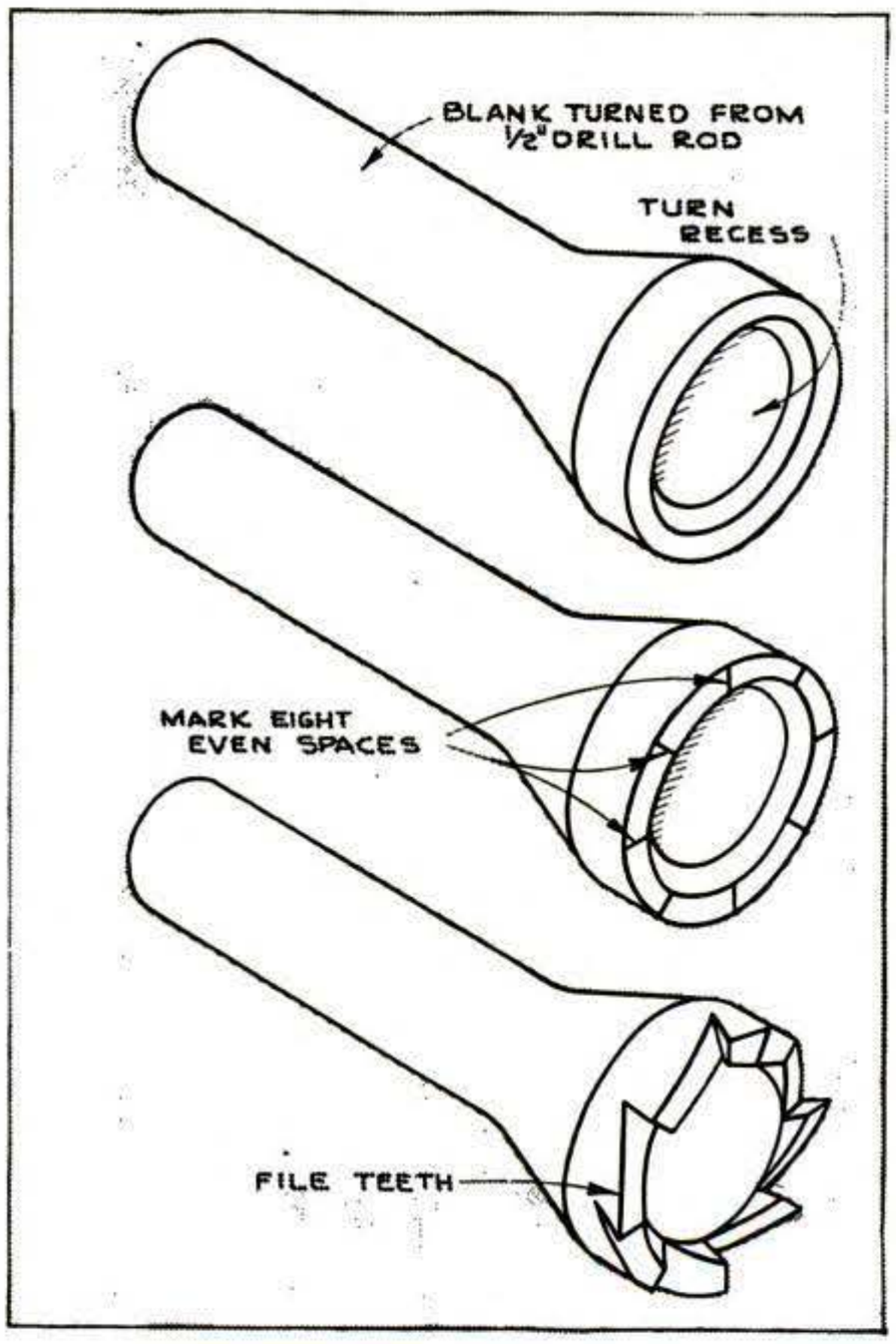
5. When stock of equal width is rabbeted, fronts of the lock stiles don't match in width. Use unequal widths at the start or glue on one molding.

Miniature Surface-Truing Cutter

RUN at high speed in the drill press, this home-made tool puts a fine surface on wood. At low speed, it mills metal to a smooth finish.

Turn the blank with a 1/16" recess. Be sure to put the bevel on the back of the teeth. Harden the cutter by heating cherry red and quenching in oil or salt water. After polishing the shank, temper by heating the shank until the straw color travels almost to the teeth; then quench. This makes a tough shank and hard teeth.





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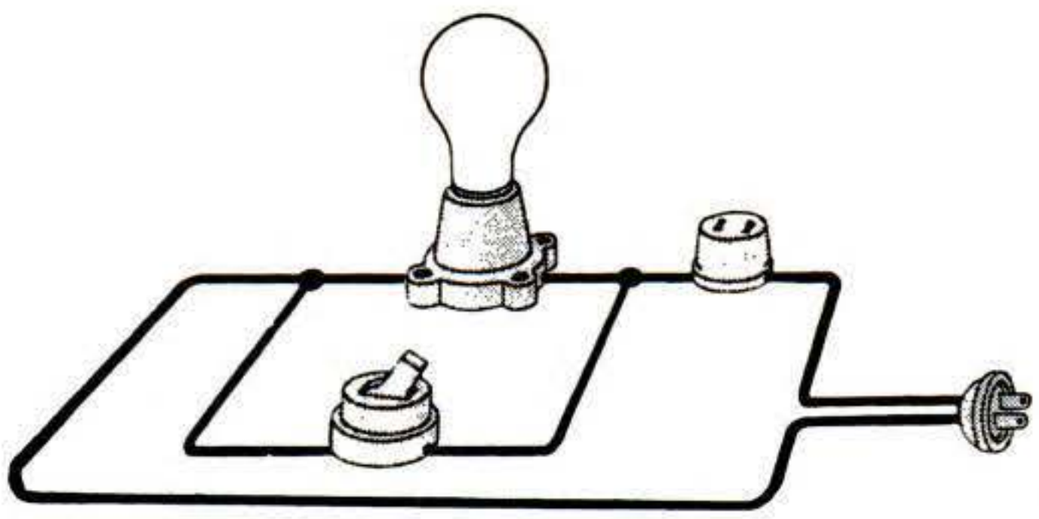
Nontip Base for Small Torch

ALCOHOL torches, being narrow and inclined to tip over easily, can be dangerous to the person handling them and a fire hazard as well. A base to prevent tipping can be made from sheet metal and fitted with upright clips of spring brass that fit around the twin barrels of this type of torch. Cut the base as a 2″ by 3″ oval; then solder the clips in place, giving them enough spring tension so that they grip the torch firmly but can be removed when desired.

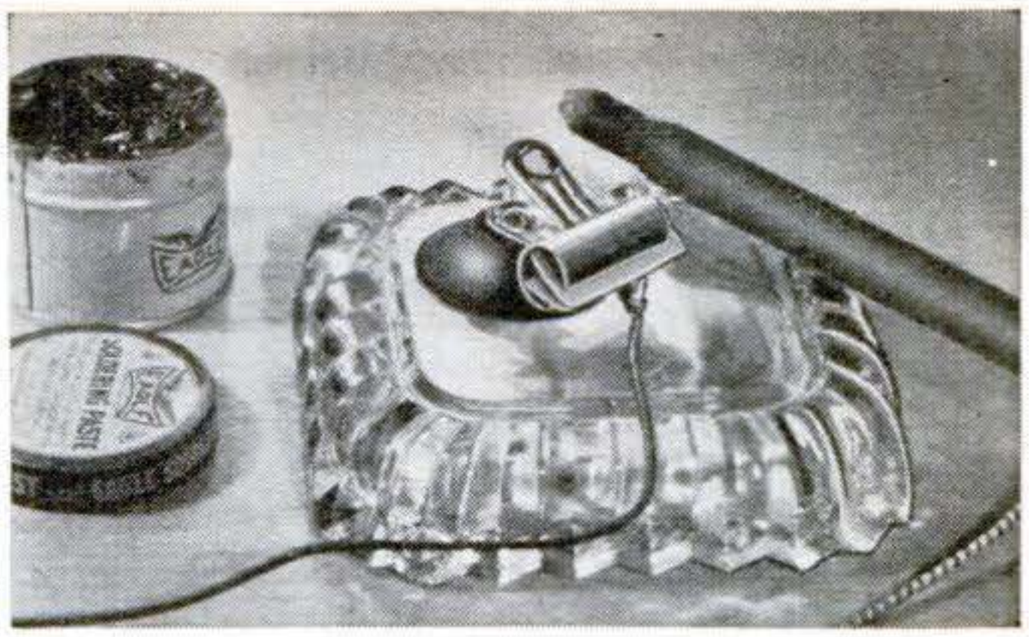
Solder Chips Mixed with Flux

SMALL shavings scraped off a strip of solder and mixed directly in the can of flux will be found useful for small soldering jobs, eliminating the sloppy runs and oversoldered joints that often result when the solder strip is applied to the work. Enough shavings should be cut from a strip at one time to load the paste in the can completely. Such a mixture can then be kept on hand for instant use whenever a job that requires just a bit of solder arises.



Test Outlet Protects Fuses

LEST the first trial of homemade radio or electrical equipment result in blowing fuses because of improper wiring, connect a 100-watt bulb in series with a test outlet as above. Plug the apparatus into this. No light at all indicates an open circuit, and a bright light a short. A glow short of full brilliance usually means it is safe to switch on full line voltage to the equipment under test.—GEORGE O. SMITH.



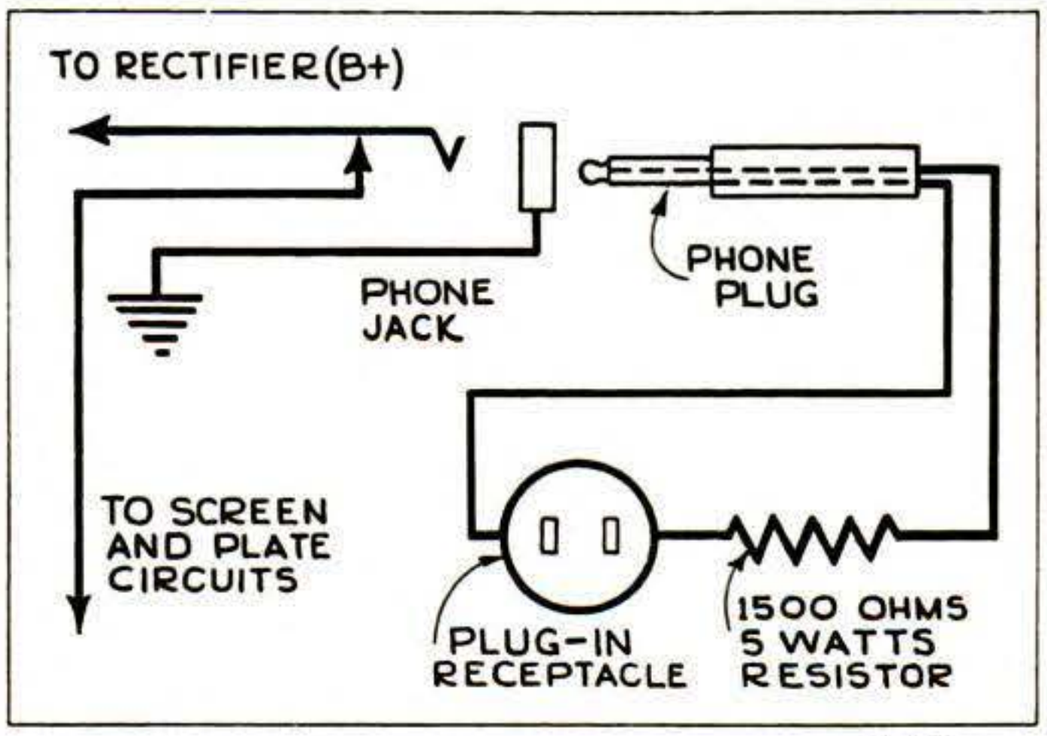
Suction Clip Is Used as Vise

A TRAVELER who has occasion to do light soldering while away from home uses a spring type paper clip affixed to a suction cup as a light-duty vise. The cup is attached to the bottom of a glass ash tray, and screws, eyelets, terminals, and the like are held in the clip when other parts are to be soldered to them. Dripping solder is caught on the ash tray, which also provides a rest for the hot iron.—GEORGE WALTON.

Shaver Operates off Car Radio

TOURISTS, salesmen, and campers can do their electric shaving on the road by using the B supply of their auto radios. A normally-closed phone jack, mounted on any free area of the radio case, is connected to the B-plus (cathode) lead from the rectifier. The phone plug is connected to a dropping resistor and a receptacle which is mounted, for convenience, on the edge of the dashboard.

Inserting the plug in the jack opens the B-plus supply to the radio and diverts it, through the resistor, to the receptacle into which the shaver is plugged. Removing the plug from the jack restores normal radio operation.—H. C. MARHOFF.



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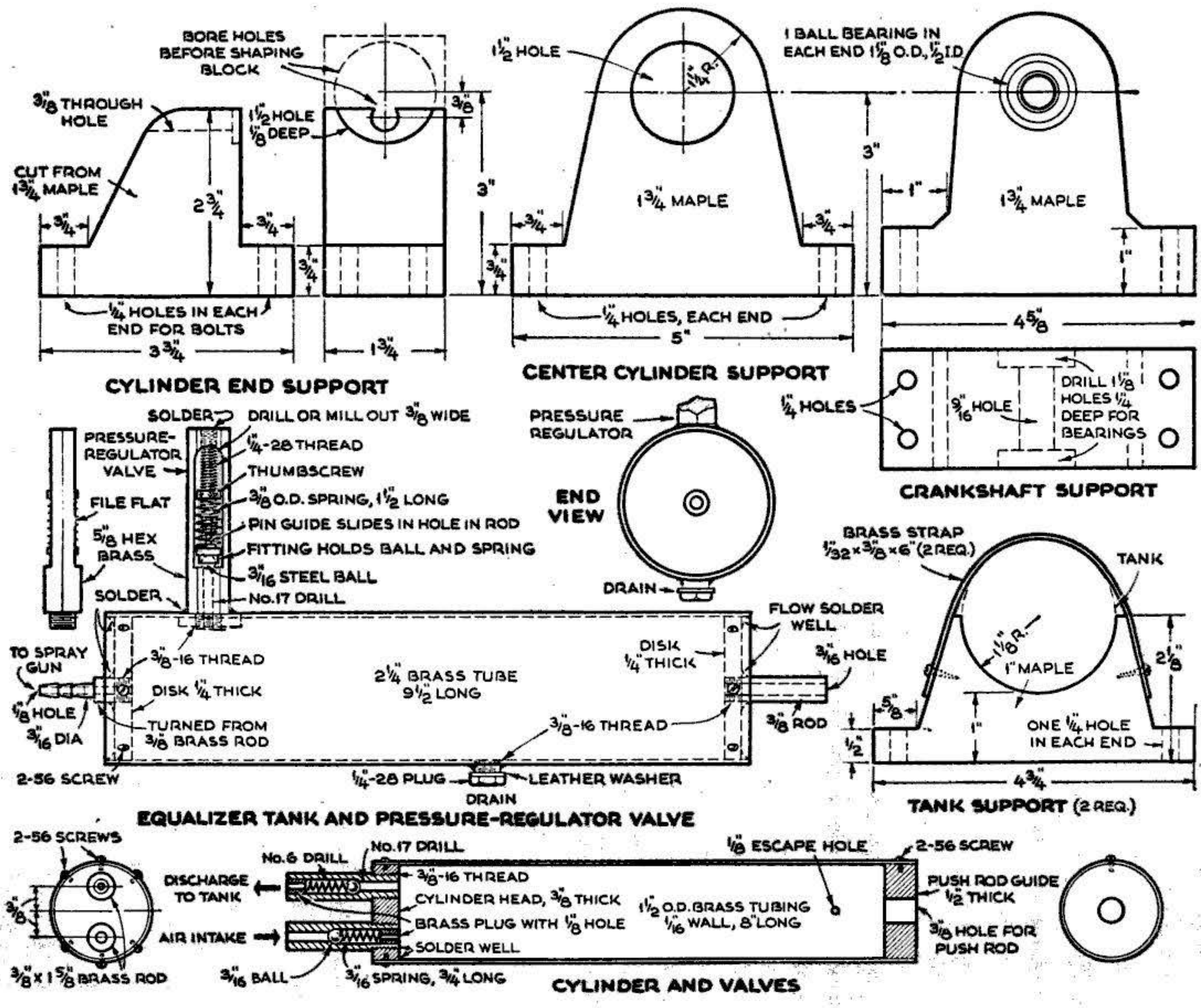

Modelmaker's PAINT SPRAYER

NO MATTER how elaborate your workshop is, it is not really complete unless it includes a good spraying outfit. A good home workshop project deserves a good finish, and there is no better finish than a nicely sprayed one. The simple and efficient compressor and spray gun described here and pictured in color on page 117 require no castings and can readily be turned out in most home shops.

The spray gun is designed especially for use with the compressor and operates on the two-nozzle principle. By selecting one of five different paint jets, you can get results that range from the almost invisible mist of a fine air brush to the heavy, even spray of a good spray gun. Not intended for use as a heavy-duty sprayer for finishing large surfaces, it is particularly adapted for producing high-grade lacquer and enamel finishes on small and medium-sized projects.

Start by making the cylinder and valve assembly. Only two valves are required; they consist of lightly spring-loaded steel bearing balls fitting loosely in holes in brass rods screwed into the cylinder head. Note that both valve springs are retained by hollow plugs. Be sure to drill the air-escape hole shown in the drawing near the other end of the cylinder, for without it there may not be sufficient clearance around the push-rod guide to let air out during the return stroke of the piston.

All joints under pressure in the cylinder and tank should be thoroughly soldered as well as tapped or threaded as indicated. Use either a torch or a large iron, taking pains to flow the solder in well. Don't solder the

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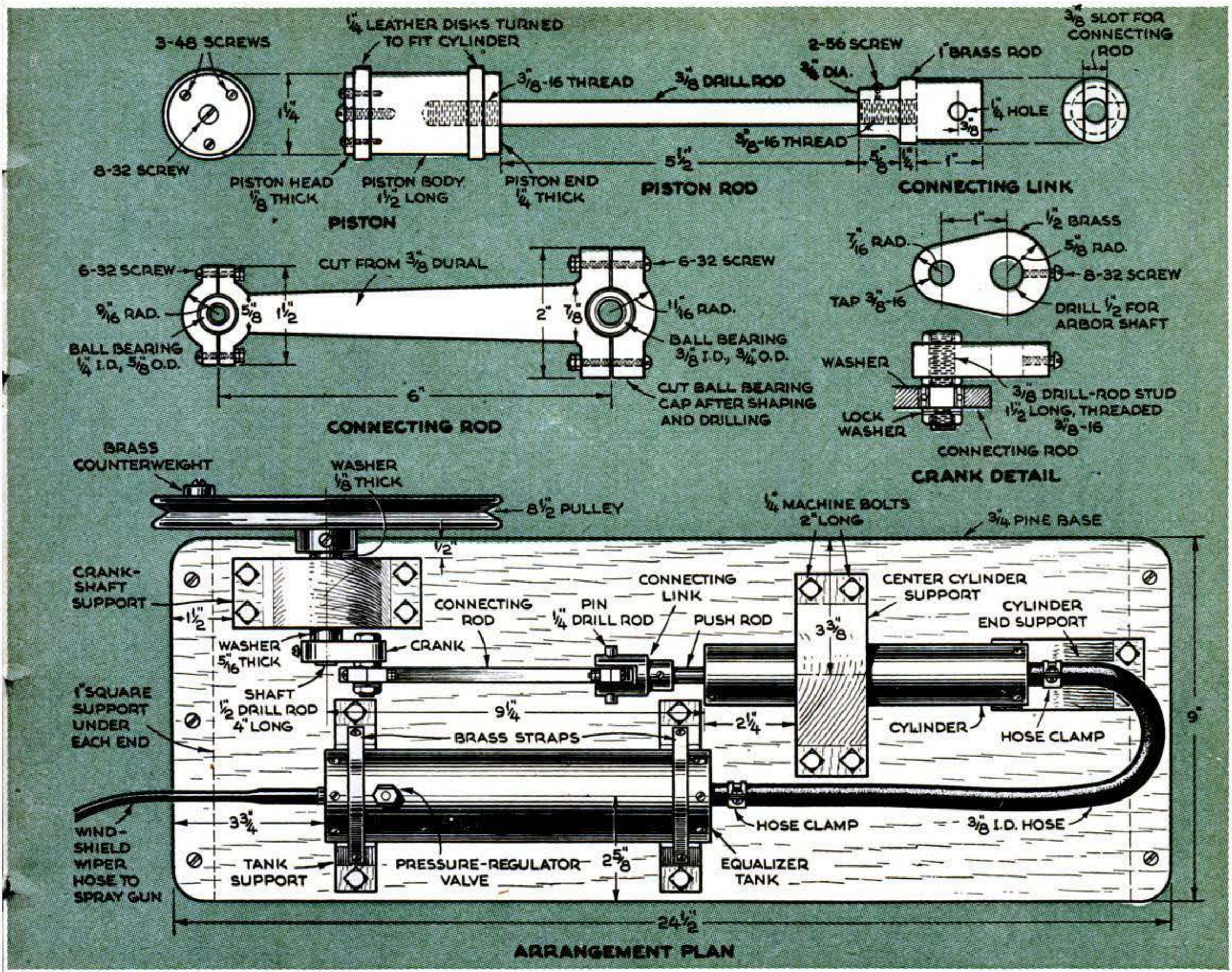
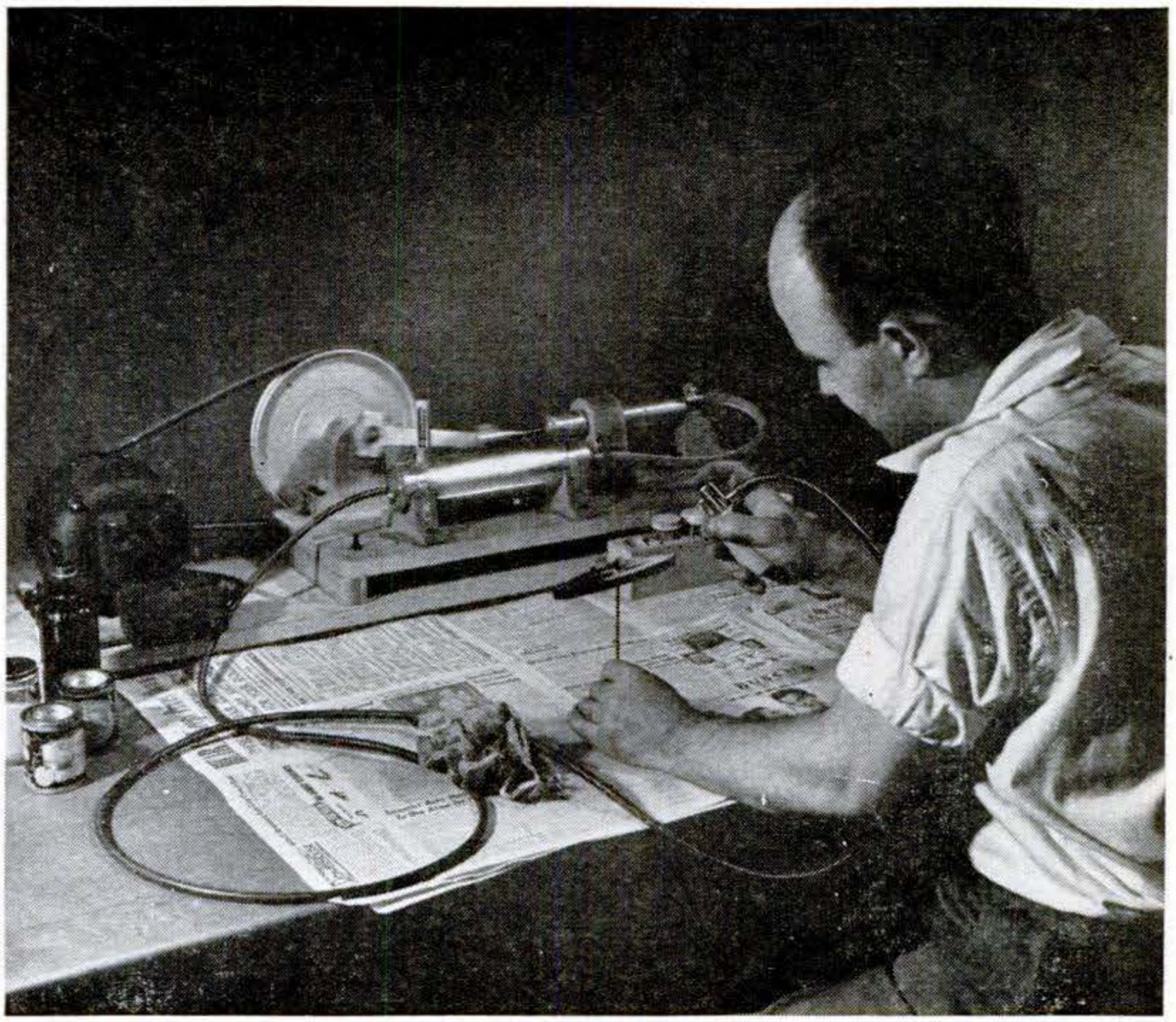


ARRANGEMENT PLAN

By
HERBERT R. PFISTER



Beautiful lacquer and enamel finishes may be "blown on" your models and other workshop projects with this handy compressor-sprayer outfit. An unfolded paper is all the protection needed; there is very little overspray if a fine jet is used. Note the paint-jar stand behind the spray gun.

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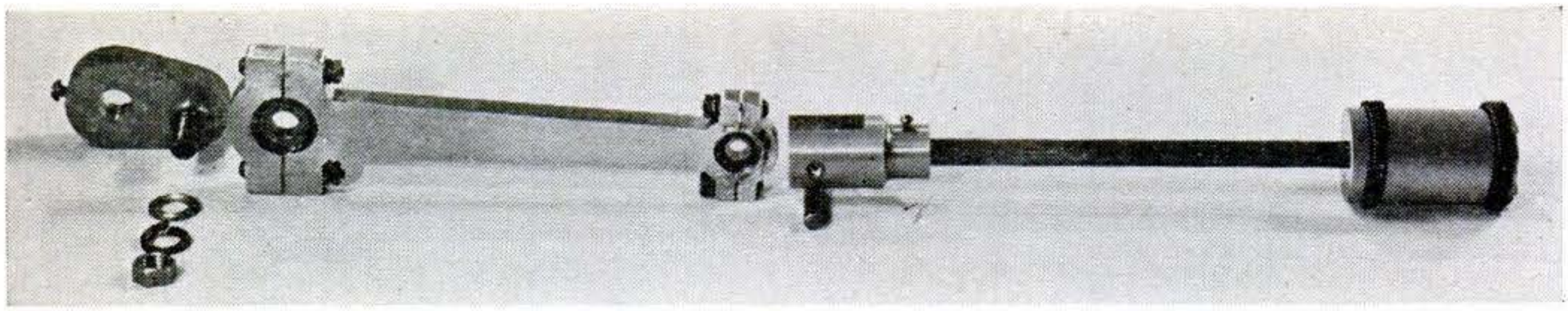

Here are the moving parts of the compressor, which has a 1 5/16" bore and a 2" stroke. Note the ball bearings in the duralumin connecting rod and the sole-leather "rings" clamped within the three-part piston.

push-rod guide in place, since it is not under air pressure and you may wish to remove it occasionally to lubricate the piston.

The piston itself, a 1⅞" length of aluminum round stock, should first be drilled and tapped as shown and then cut into three parts. The "rings" are two pieces of old leather shoe sole about ¼" thick that are cut in roughly circular shape, soaked in oil, and mounted between the parts of the piston. Turn the leather in the lathe to a snug sliding fit in the cylinder.

Saw out the connecting rod from a piece of ⅜" duralumin or ¾" maple. Do not use steel or brass for this part, since the extra reciprocating weight will encourage vibration. The crank, which is more heavily stressed, should be made of either brass or steel. It is threaded to take a ⅜" drill-rod stud that is locked in place by a thin nut on each side. The portion that fits within the connecting-rod ball bearing need not be threaded.

The equalizer tank is not intended for storing compressed air, but merely for leveling out compressor pulses before they reach the spray gun. The drain plug on the bottom permits removal of any condensation; while you will probably not use it very often, it is handy to have since the ends of the tank are soldered in tight. The pressure-regulator valve, detailed in the drawing on page 174, serves both to maintain the desired spraying pressure and to act as a safety valve. It consists of a length of ⅝" brass hex stock, filed or milled flat for part of its length, and drilled and filed out to make a cage for the ball valve and its spring loaded follower.

When you assemble both this valve and the two in the cylinder, strike the steel ball a single smart blow with a hammer and punch after dropping it in place. This will insure good seating. Spraying pressure is increased by screwing the thumb nut down on the spring. A little experimentation will give you the "feel" of the regulator setting.

Lay out the crankshaft support and the cylinder supports on blocks of maple or other hardwood. In the case of the outboard cylinder support, holes to receive the intake valve and the end of the cylinder should be bored before the outline of the block is bandsawed. Before boring the holes in the crankshaft support, experiment with an expansive bit in a piece of scrap stock to get a setting that will make a press fit for the two ball bearings. Unless these bearings are snug, the compressor will knock like an old car.

After cutting out the two tank supports, make a trial assembly of the parts on a ¾" baseboard, and if everything checks, bolt the parts down with ¼" machine screws. The cleats at the ends of the baseboard, which give clearance for the large pulley, eliminate the need for recessing the nuts. Before installing the piston, put a few drops of heavy oil mixed with powdered graphite into the cylinder and spread cup grease around the piston body between the leather rings, packing in as much as you can. As indicated in the drawing on page 175, several special washers are called for on the crankshaft assembly. These may be turned from ¾" brass rod drilled with a ½" hole, or a number of regular washers can be used.

Give the wood parts several coats of shellac, and polish and lacquer the brass parts. Belt the compressor to achieve a crankshaft speed of about 300 r.p.m. With a ¼-h.p. motor turning at 1,750 r.p.m., this will be secured with a 1½" pulley on the motor driving an 8½" one on the compressor crankshaft.

The spray gun employs a constant air-flow system, has no moving parts nor valves, and can be cleaned in a few seconds. It consists of a small screw-top jar (the writer used jars originally containing a popular headache remedy) provided with two jet nozzles and an air-escape hole. The user holds it as shown in the photograph on page 175, with an index finger over the ⅛" escape

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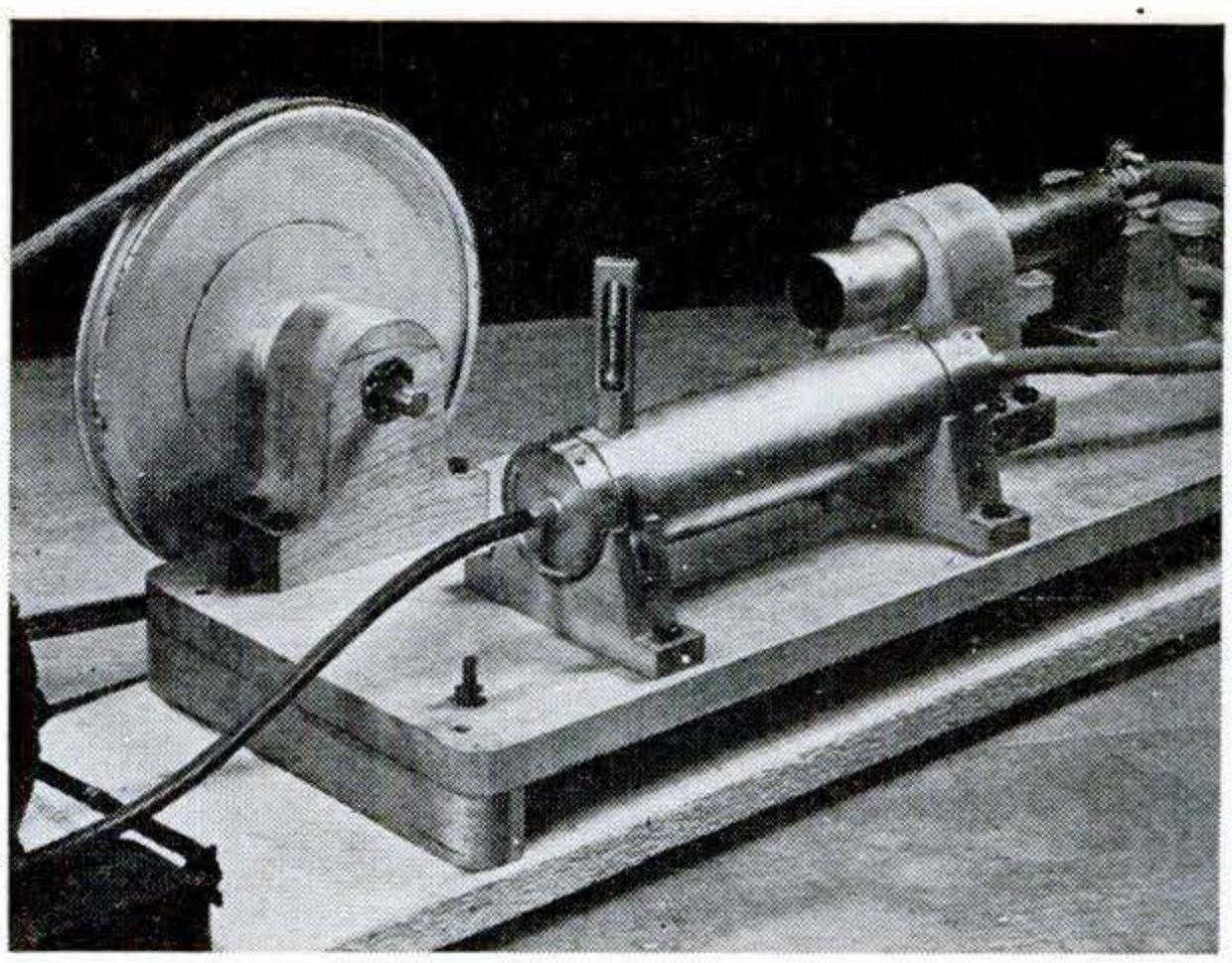
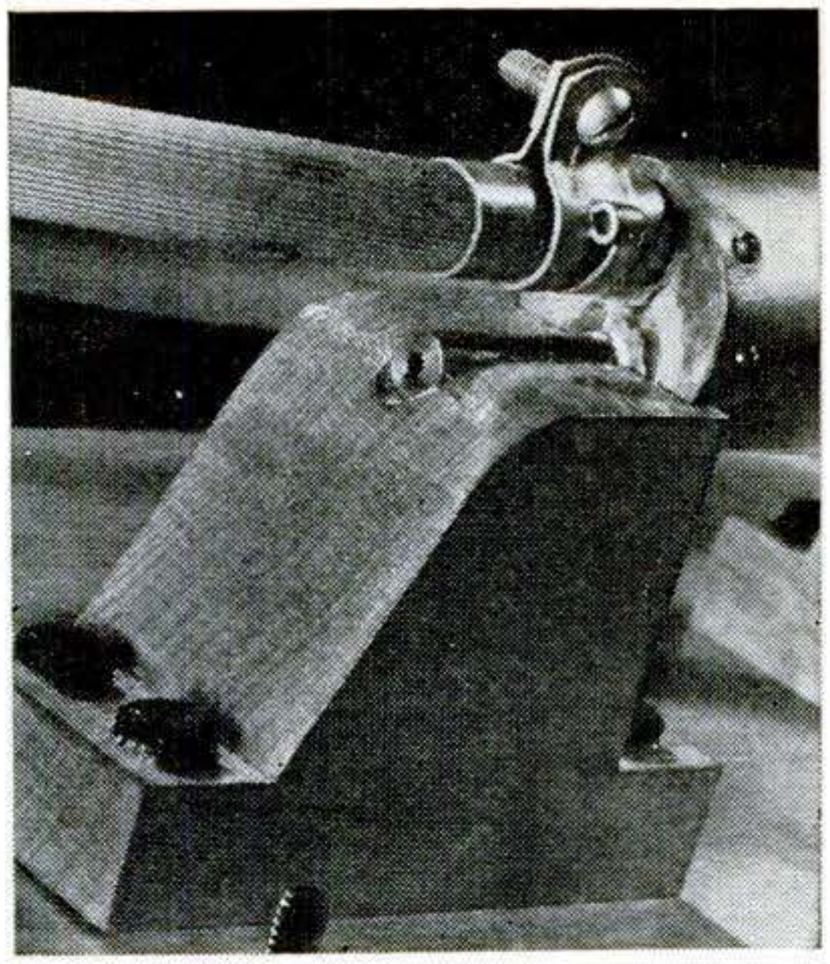


Closeup of the compressor with the reciprocating parts removed. A spring-loaded ball valve on the equalizer tank, foreground, adjusts pressure and serves as a safety valve.



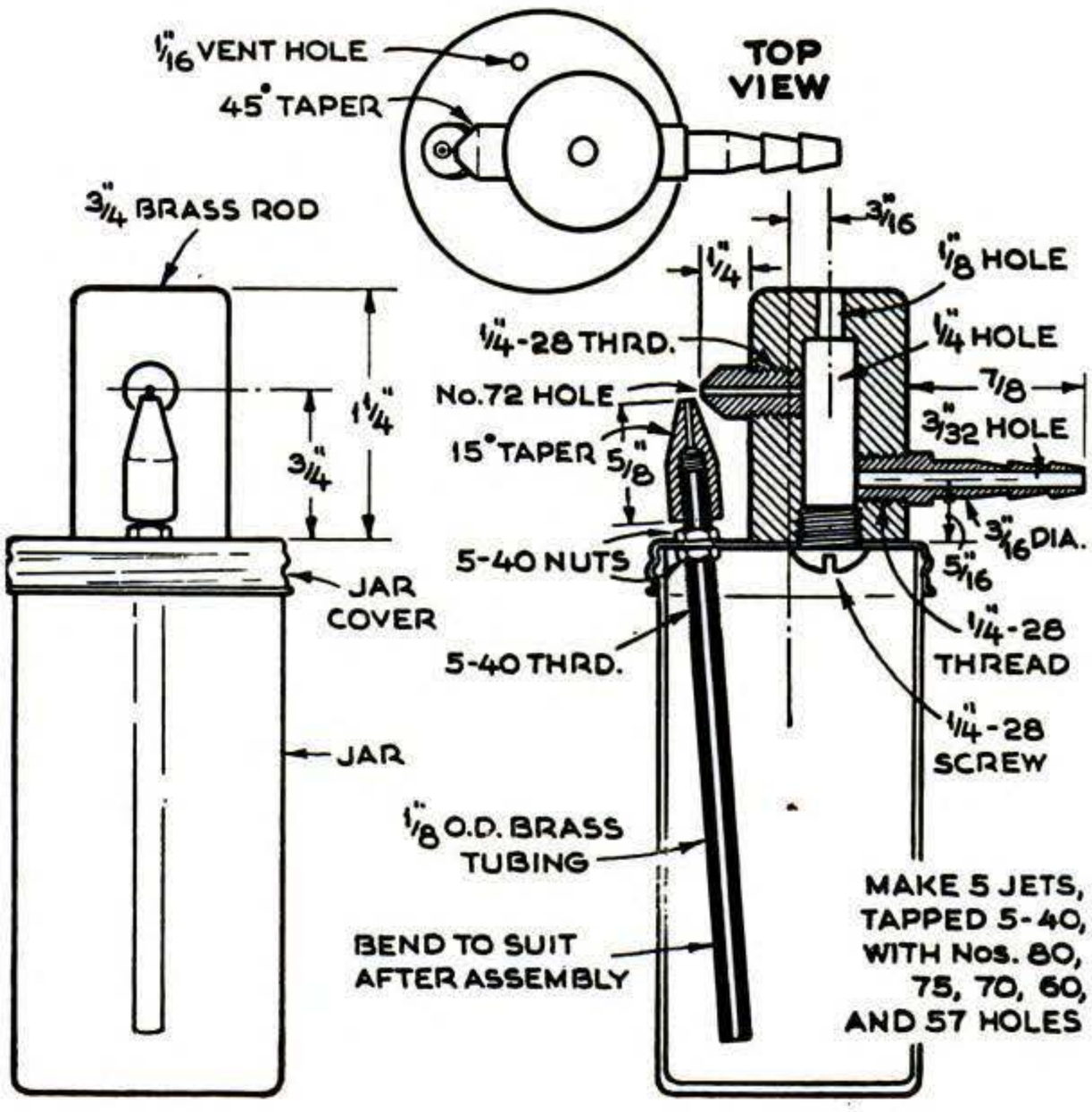
Valve end of the cylinder, showing the intake valve and notched support block. A delivery valve is hidden by the hose.

hole. This directs a stream of air through the air jet, sucking out paint from the paint jet. To stop spraying for a moment, the user need only lift his finger, allowing the air to bypass the air jet. The five paint jets specified in the drawing will spray everything from highly thinned lacquers to heavy enamels.

A 10′ length of 3/16″ windshield wiper hose connects the gun to the compressor tank. After spraying, wash the gun by spraying a few bursts of thinner through it until the paint jet and tube are clear.

For simplicity in changing colors and to eliminate messy steps, collect an assortment of jars that you can keep filled with different colors of lacquer and enamel. It will then be necessary only to switch the cover with the spraying head attached to another jar when you wish to change colors or clean the gun.

Here's the gun itself. With carefully positioned air and paint jets, it will blow an even coat ranging from fine mist to heavy spray. A set of screw-top jars makes quick cleaning and color changing possible.



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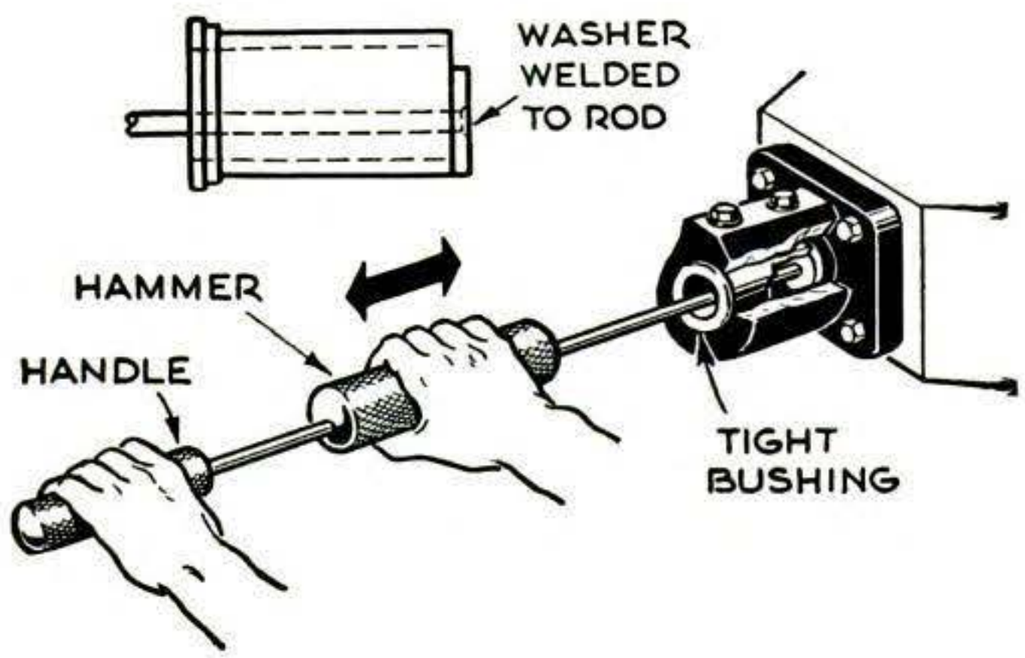
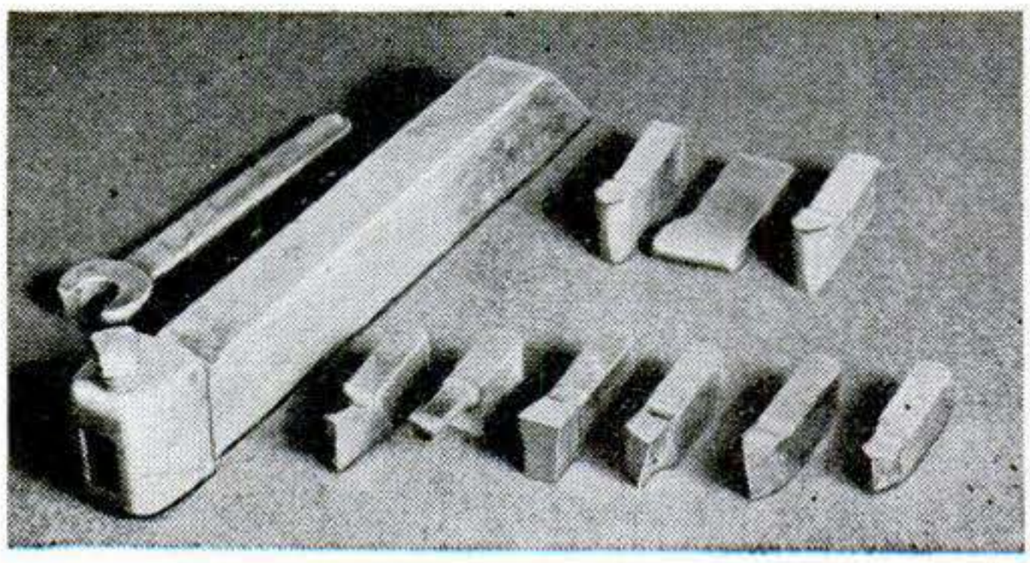
NEW SHOP IDEAS

BUSHING EXTRACTOR. When a tight bushing can't be driven out from the back, the tool shown below will pull it. The welded washer is inserted in the bushing from the front and hooked over the edge, and the sliding hammer is then brought sharply against the handle several times until the bushing loosens and comes out. Carl Bagford, of Cedarville, Ohio, devised the tool for removing bushings from a lathe turret when setting up new work. The tool was first described in *Blue Chips,* a publication of Warner & Swasey Co., of Cleveland.



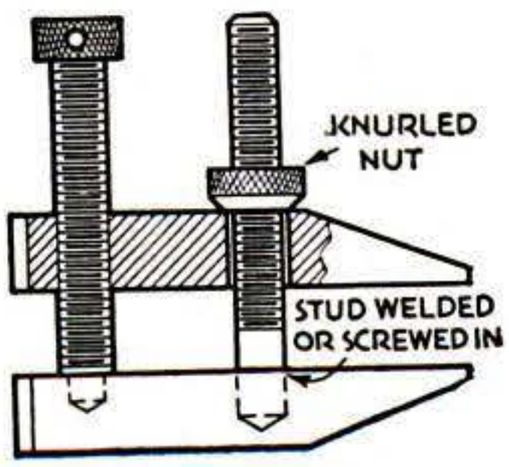
LATHE BITS FROM SAW TEETH. A complete set of bits for a lathe or shaper can be made from worn high-speed steel saw teeth of the large inserted kind. They will need only a tool holder to fit the lathe or shaper, and this can be made from machine steel and case- or pack-hardened. A setscrew clamps the bit in the holder for use. Three saw teeth before shaping are shown in the background of the photo below, and six bits ground for handling a variety of different lathe jobs are shown in the foreground.



BLOWTORCH SOLDERING IRON. When electricity is not available, the copper tip of an electric soldering iron can be transferred to a small gasoline or alcohol torch. Attach the tip to the jet tube with stiff, heavy wire so the flame will enter the tip. The size of the flame is adjusted according to the size of the work to keep the tip at soldering temperature continuously, care being taken not to burn the copper.

OILSTONE KEPT IN KEROSENE. A discarded oblong butter dish is just the right shape for holding an oilstone and is an excellent container for keeping one soaking in kerosene at all times. You will find that a saturated stone will put a keener edge on your tools and will work much faster than one that is only occasionally oiled.

CLAMP WORKED FROM ONE SIDE. A machinist's clamp having both screws on the same side has advantages over an ordinary clamp that must be tightened from both sides. Not only is it easier to handle, but it eliminates a common cause of interference in difficult setups. One end of the stud carrying the knurled nut is screwed tightly into or welded to the lower jaw of the clamp and is a free sliding fit in the upper jaw. Adjustment for size is made with the knurled nut. Then the clamp is tightened on the work by means of the second screw, which turns freely in the lower jaw and screws into threads in the upper.



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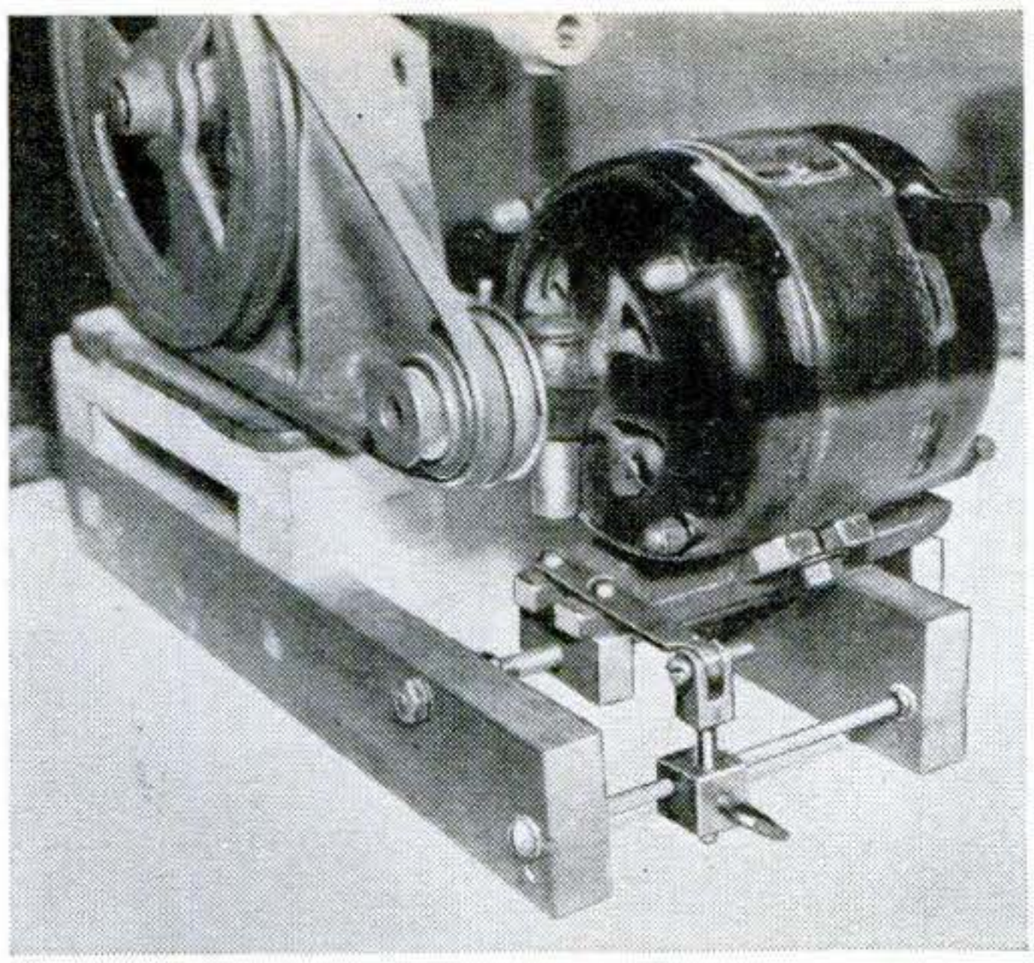
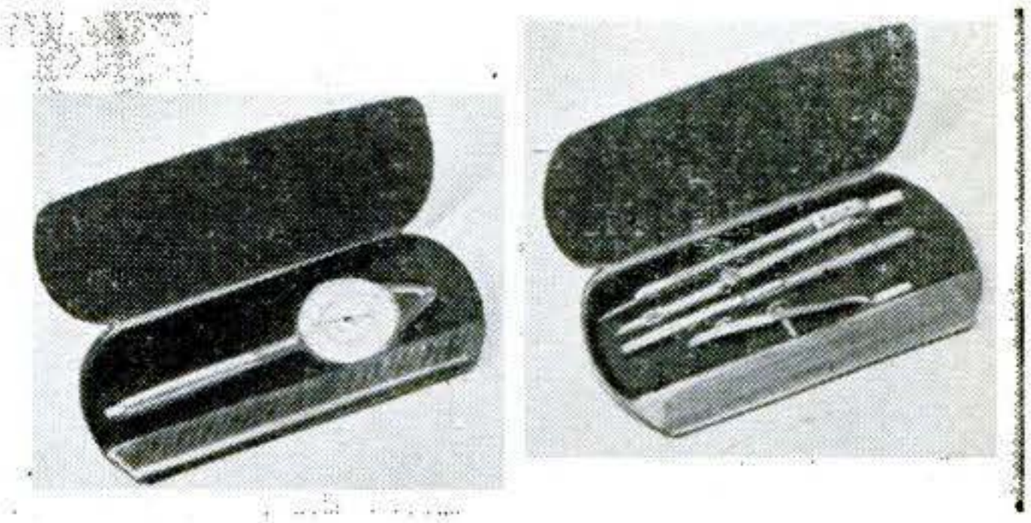


MOTOR BELT-LOCKING ADJUSTMENT. This motor is mounted on two blocks that slide on a rod to bring one of its three pulley steps into adjustment. Also attached to the motor mount is a hinged locking and tensioning arm having on its end a setscrew-fitted block sliding on a second rod. When speeds are changed, the setscrew is loosened and the motor is slid on the mounting rod until the proper pulley step is in alignment with the driven wheel. The arm is then adjusted for belt tension, and the thumbscrew is locked.

OFFSET SCREWDRIVER. One or more of these tools for getting at screws the customary screwdriver can't reach are quickly made from hexagon socket wrenches. They are widely available in sizes from 5/64" to 5/8" across the flats. The use to which the screwdriver is to be put will determine the size of both the wrench and the blade ground on it.

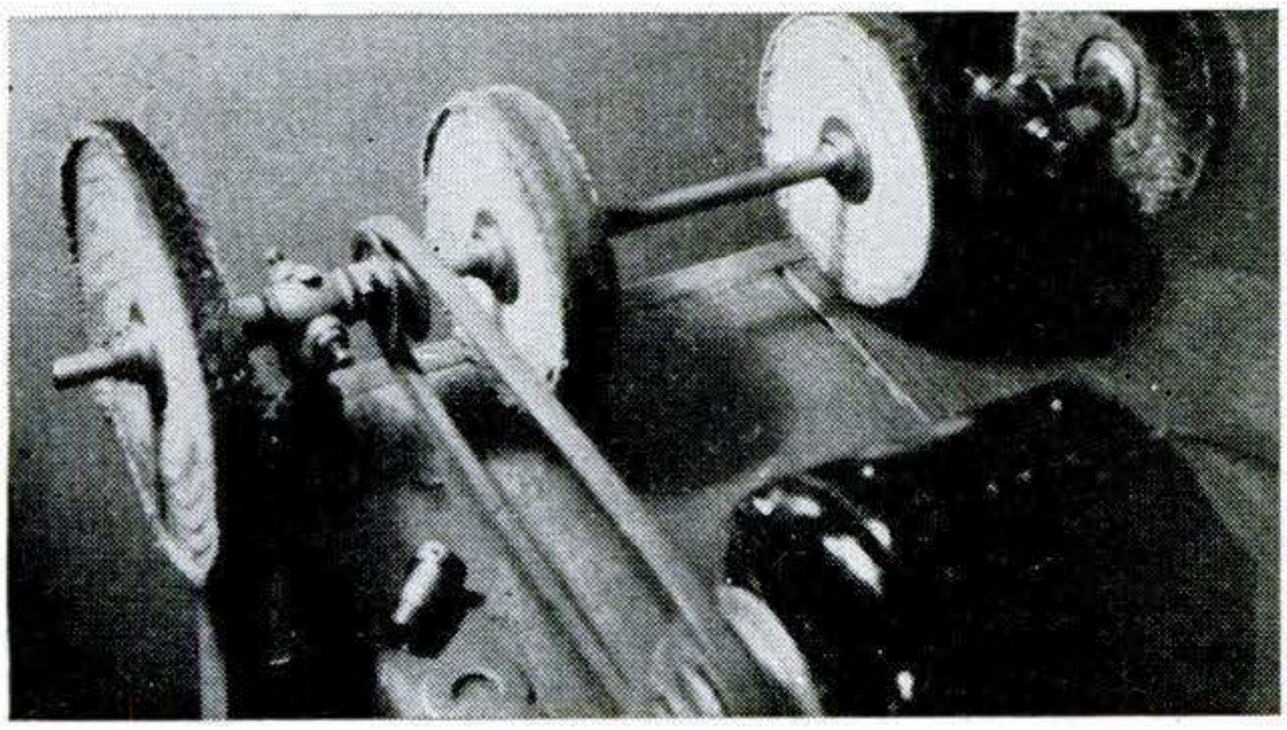
SMALL-INSTRUMENT CASE. Old spectacle cases of the hard, hinged-top kind make excellent pocket cases for drawing instruments, dial indicators, gauges, and the like. Most are long enough for a compass and pen.

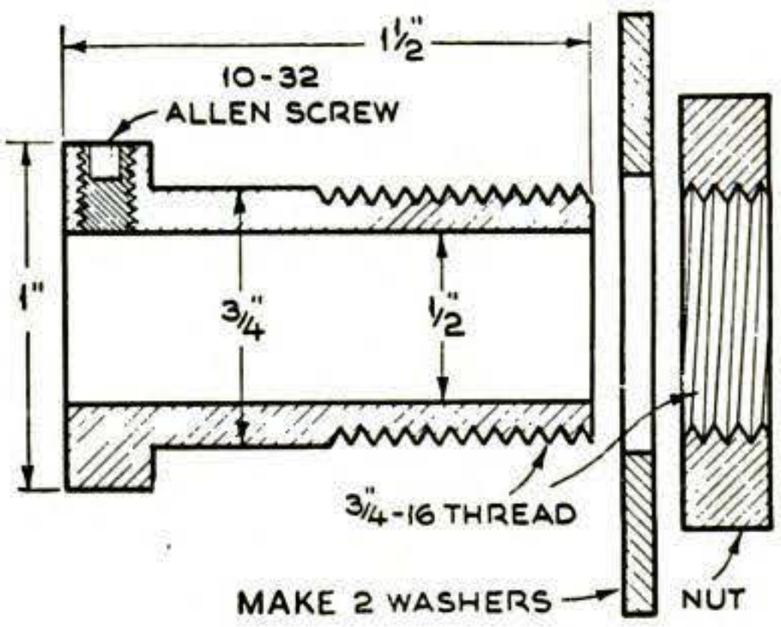


MULTIPLE POLISHING WHEELS. This is an idea borrowed from shoe-repair shops, and it works exceptionally well for buffing and polishing metal, wood, or plastic. The craftsman may proceed from a scratch wheel to one with a hard abrasive grit, and then on to a soft-polishing wheel and a clean buff, thus completing a job in one swift sequence.

A 24" length of ½" shafting turning in self-aligning bearings serves as the drive shaft. The wheels are fitted with adapters, set on the shaft, and held with setscrews. Any number may be used depending on the length of the shaft.

All wheels should be in good balance. Buffing and muslin wheels may be balanced with the adapters on a short length of ½" rod laid on two level straightedges. Drill the light side and insert a piece of solid wire solder, peening the ends.—JOHN MRACEK.





Individual adapters are turned from ordinary cold-rolled steel. A setscrew locks each on the shaft.

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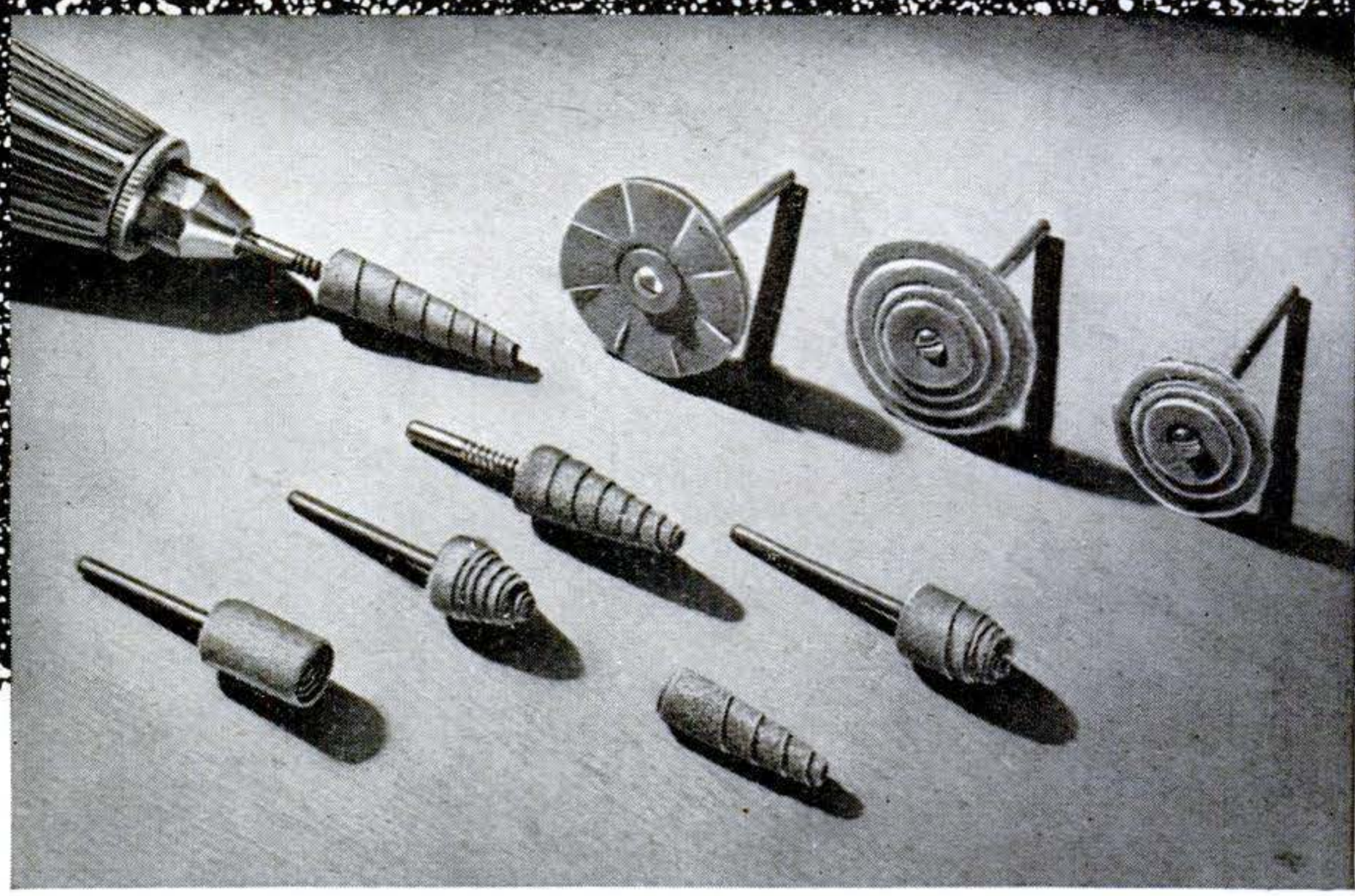
ABRASIVES Smooth the Rough Jobs



Spiral, cylinder, and cartridge rolls, as well as slotted or pyramided disks of abrasive cloths, do fine finishing and polishing in difficult spots when chucked in an electric hand tool.

By WALTER E. BURTON

ABRASIVE cloths and papers are known to every craftsman as highly efficient for smoothing wood and metal, cleaning surfaces, and knocking off sharp edges and corners. But such "sanding" is only a beginning, for coated abrasives can be converted into many special tools for work that otherwise would be difficult or even impossible. In industry, hard-to-get-at places such as recessed areas, holes, valve seats, and gear teeth are burred, rounded on the edges, and polished with abrasive cloths and papers in various forms. Many a small commercial or home shop can profit by taking a leaf from industry's book.

The rusted, rough groove of a round-belt pulley, for example, is easily smoothed with an aluminum oxide "rope" seesawed around it. Cut a strip of 80-, 100-, or 120-grit abrasive cloth ½″ or so wide, coat the back with glue, and wrap it spirally around a length of sash cord or other rope. Fasten the ends with string or adhesive tape until the glue sets. If the spiral has a tendency to loosen while the glue is wet, twist the rope so that when it is released its untwisting will tighten the spiral.

A piece of rope 12″ long with an abrasive section of 8″ or 9″ is handy to manipulate. Countless uses can be found for a collection of such ropes of different diameters. They will smooth grooves in metal, wood, and plastics, clean out various kinds of holes, reach odd corners in cabinetwork, and clean rust from automobile parts. The grit should be selected to suit the work. For metal, aluminum oxide cloth is generally satisfactory; for wood and plastics, aluminum

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oxide, silicon carbide, and garnet are used.

Ordinary sandpaper is sometimes difficult to wrap around a small core unless it is first softened by steaming a little. Any coated abrasive, if allowed to become too dry, may crack when bent around a small diameter. For fastening, casein glue, fish and hide glues, household cement, and leather-belt cement are all good. The trick of softening coated abrasives with steam may be used to create various specialized tools. An ordinary teakettle containing a small quantity of water will provide enough steam for most purposes. Take care not to overdo the steaming, or you may damage the abrasive coating by loosening the bond.

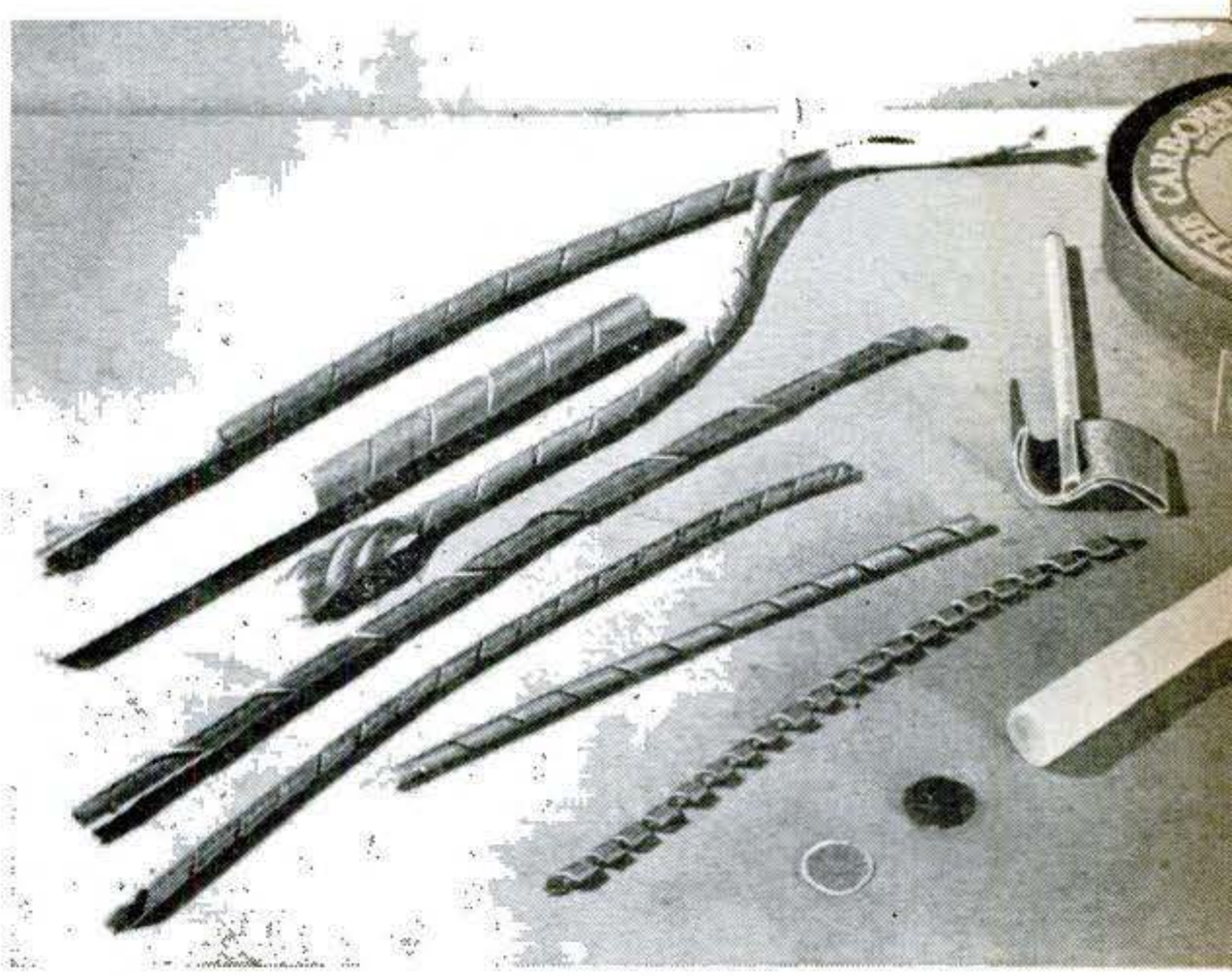
Somewhat similar to abrasive ropes are coated-abrasive spirals made from strips of abrasive cloth wound solidly on wires or rods, steamed to soften the glue bonding the grit to the backing, and then dried. When removed from the mandrels, the spirals retain their shape. They are useful in numerous jobs that require flexibility and a light touch. The usual length of spirals is 8″. Because there is no fixed core, spirals accommodate themselves to a wider range of diameters than ropes.

A handy workshop tool is made by gluing a spiral strip of abrasive cloth or paper to a wooden dowel or metal rod. When the abrasive section is 4″ or more long and there is enough bare stock for a handle, the tool can be used like a hand file for smoothing grooves, holes, and many curved surfaces.

In a similar form, but short enough to prevent whipping, such a sanding stick may be chucked in a drill press or lathe and used much like a small-diameter grinding wheel for smoothing jigsawed work, various kinds of metal contours, die cavities, and the like. When one section of the abrasive area becomes worn, the stick or work is shifted to bring a new area into action. There is a drill-press attachment for oscillating a spindle vertically to bring a large area of the stick (or a sanding drum) into contact with the work and produce a smooth finish and uniform grit wear.

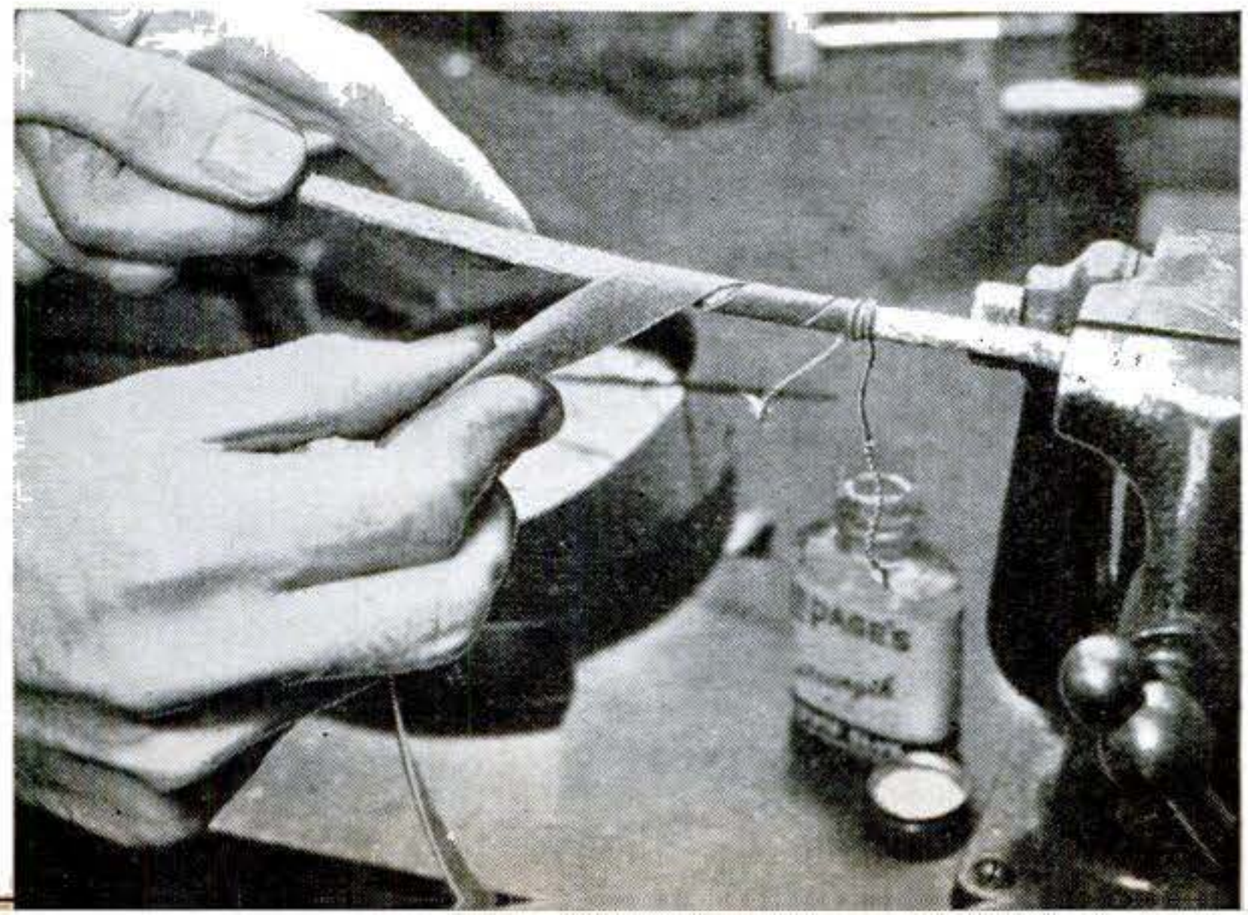
When the handle of an abrasive stick is shaped so it can be clamped in the lower blade jaw of a jigsaw, still another handy arrangement results. Because of the considerable side thrust that may be exerted, a metal core is preferable to a wooden one for use in a jigsaw.

One example of steam-forming abrasive cloth is for a sanding drum with a convex face for smoothing shallow grooves. The drum is made with aluminum oxide cloth on a turned wooden core mounted on a grinding-wheel arbor. A strip of the abrasive cloth is trimmed to the required width, steamed lightly to soften the bond, trimmed

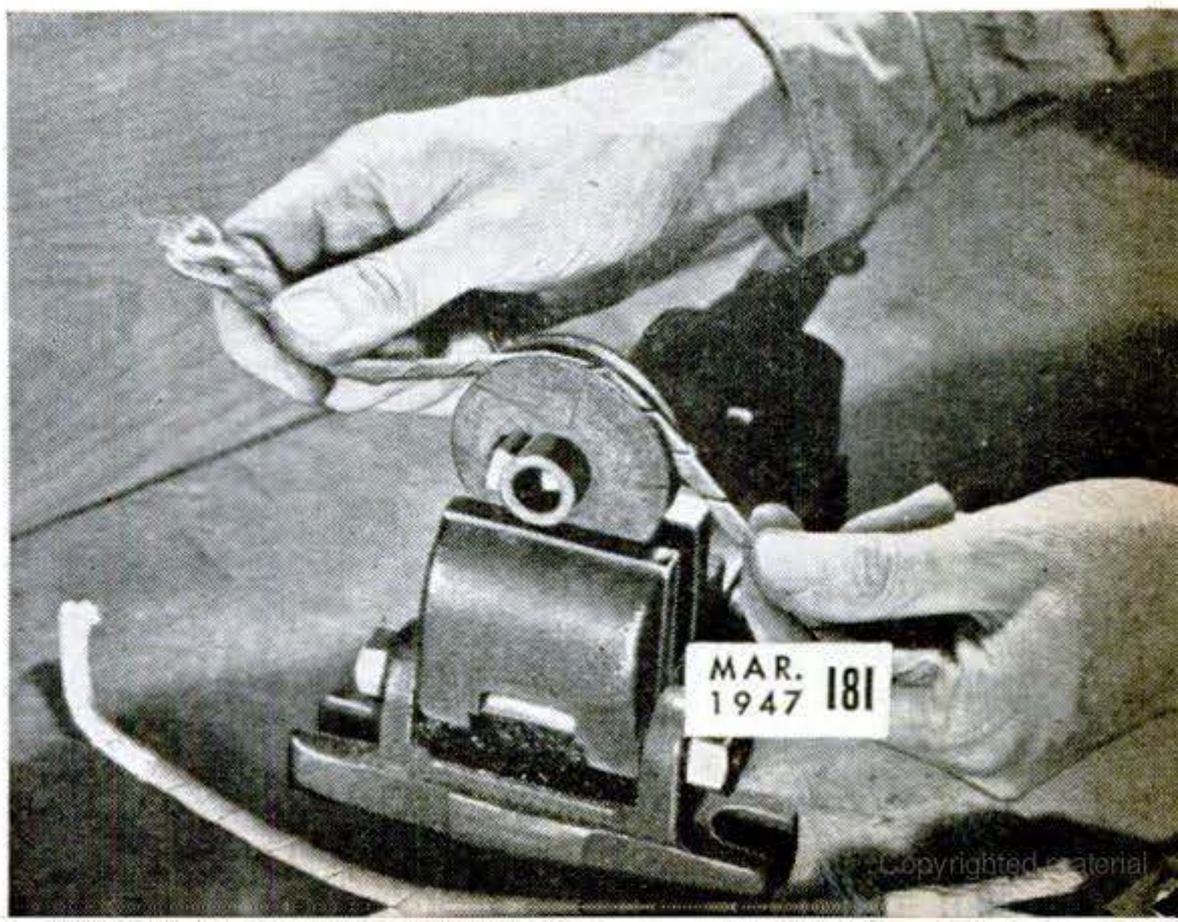


Abrasive "ropes," sticks, and spirals, butterfly sanders, and spot polishers are tools for special jobs that can be made from abrasive strips.

Coated on the back with glue and wrapped around a heavy cord, an abrasive strip becomes a handy abrasive rope. The ends are tied until the glue has set.



Easy to manipulate, abrasive ropes can be seesawed back and forth to smooth holes and round grooves in metal, wood, and plastics.



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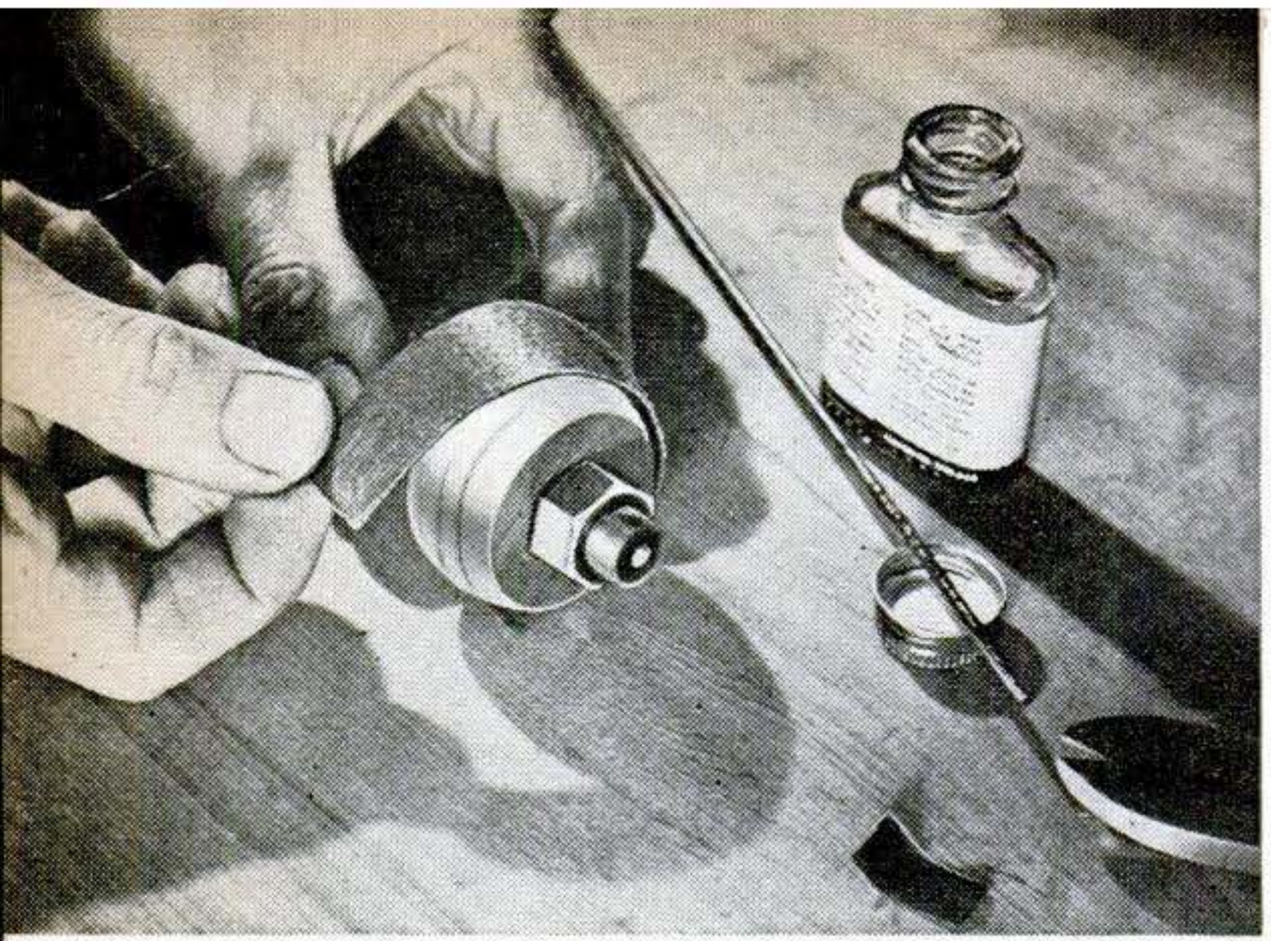
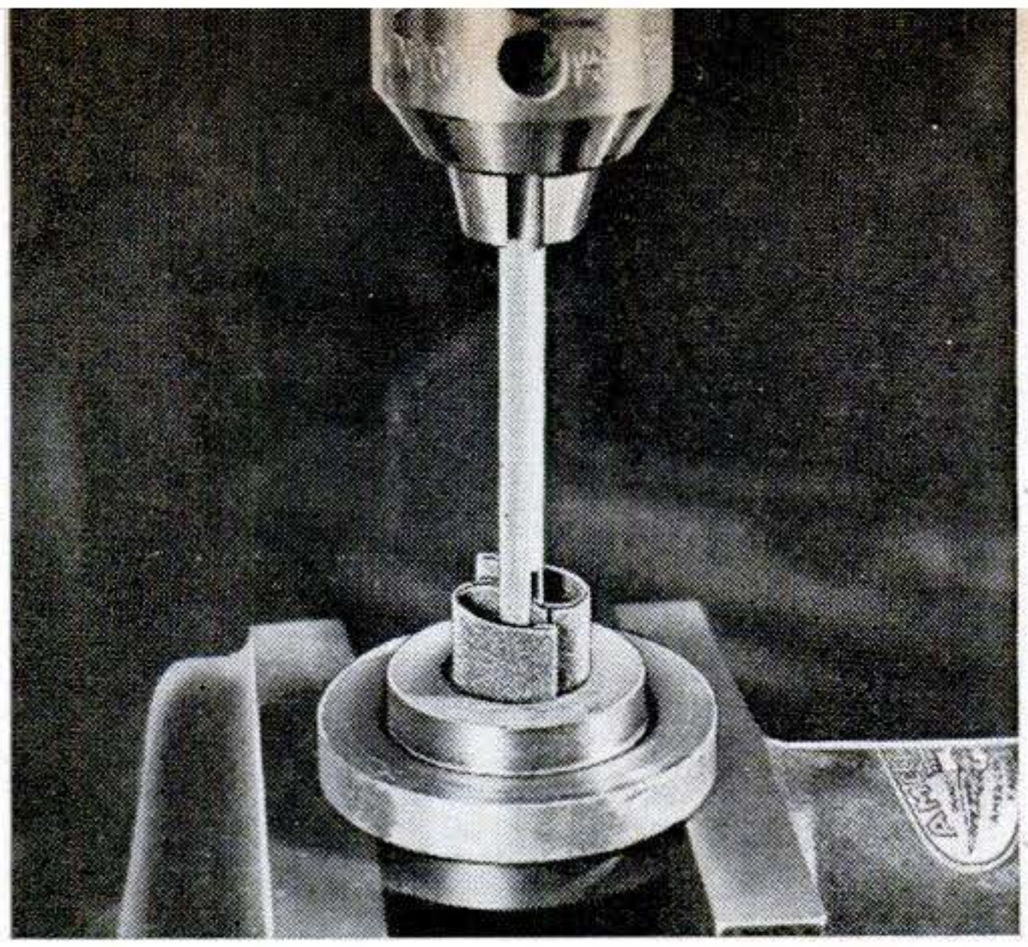
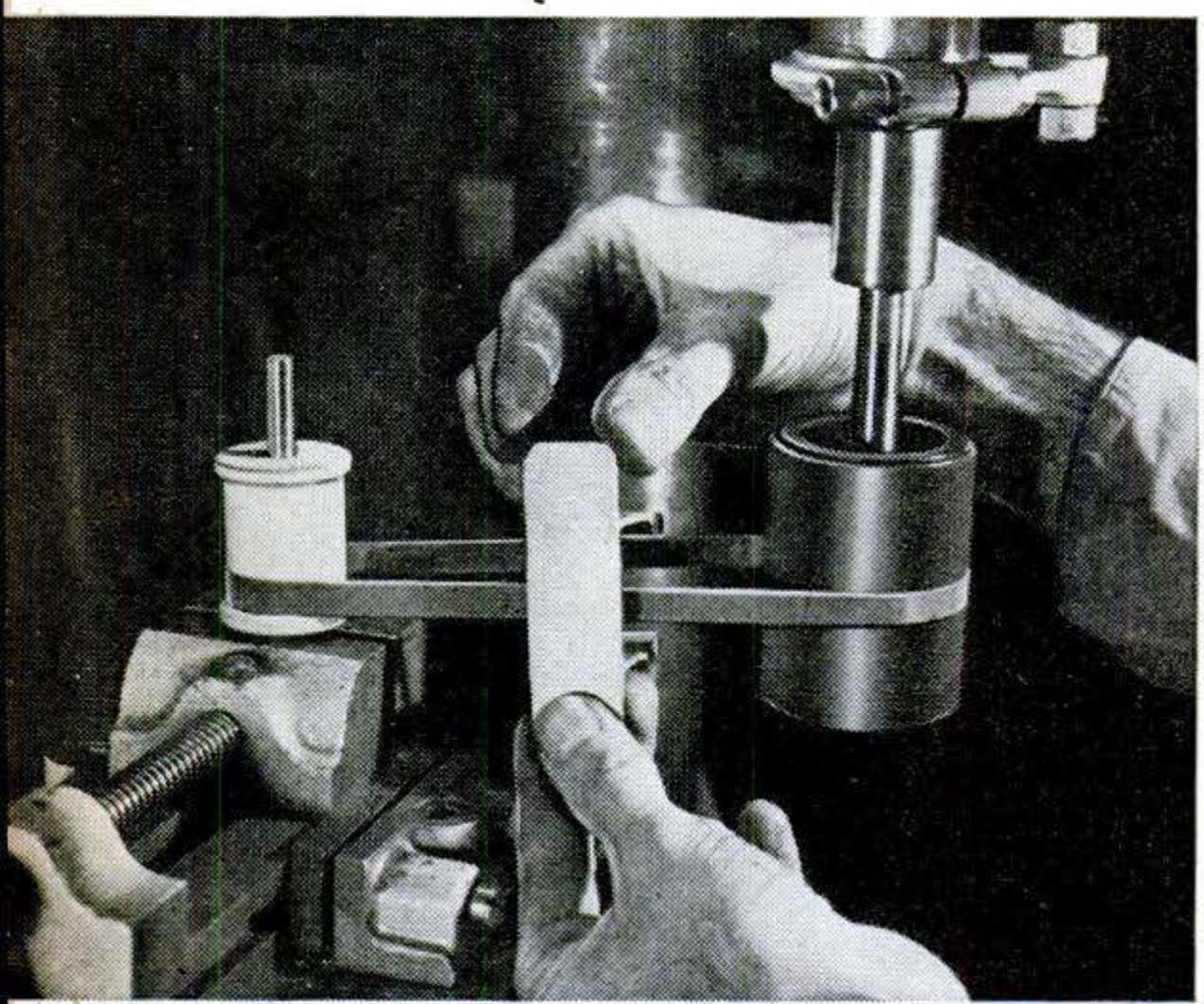


Abrasive cloth is adaptable for gluing on shaped surfaces. Here a piece is put on a turned wooden drum having a convex face. Softening with steam is sometimes needed to make grit bond pliable.



Butterfly tools made from abrasive cloth and used in the drill press will clean and polish a hole without removing much material. This one is made by inserting a doubled strip in a slotted rod.



Narrow sanding belts formed by gluing the ends of a length of abrasive strip do a variety of work. This belt is driven by a rubber sanding drum in the drill press. The idler is a wooden spool.

for a butt joint, and then either glued to the drum while still pliable or bound around the drum until dry before gluing.

Belts made by joining the ends of abrasive-cloth strips have many uses. The splice is usually a lap joint, with the ends either diagonal or square. All grit is removed from the cloth backing at one end to make the glue joint cloth to cloth. On small areas this can be done with a coarse file or abrasive stone, or the bond can be softened with steam and the coating scraped off.

A handy way of rigging up an abrasive belt in the home workship is shown in the lower photo above. The belt shown was made from a narrow strip of aluminum oxide cloth. It is driven by a rubber sanding drum in the drill-press chuck, and a wooden spool rotating on a steel rod in a drill-press vise clamped to the table serves as an idler. By tapping the upper end of the rod, the spool can be aligned so the belt will track evenly. Belt tension may be varied to let the belt follow the contour of the work. This arrangement, quickly set up or dismantled, is handy for smoothing many kinds of materials. A vertical rest or table may be arranged to hold the work at right angles to the belt.

Bands or sleeves for sanding drums are made by wrapping the abrasive strip around a mandrel and gluing the ends in a diagonal splice similar to that for a belt. Usually, however, it is simpler to buy such sleeves ready-made. Always run a drum or belt so the work won't tear the splice.

For cleaning holes without removing much material, a butterfly tool is sometimes the best answer. A simple one can be made by sawing a slot in one end of a length of metal rod for a distance of about 1⅛″ and forcing a doubled 1″ strip of abrasive cloth into the slot. The tool is chucked in a drill press or lathe, and the abrasive strip is bent into an S and inserted in the work before power is applied.

Most of the hand-grinder sets that consist of a high-speed motor and various mounted abrasive wheels, drills, rotary files, and tiny sanding drums have some arbors or mandrels on which disk attachments can be mounted. One or more disks of abrasive cloth on such an arbor may prove a tool that will save hours on such jobs as burring the

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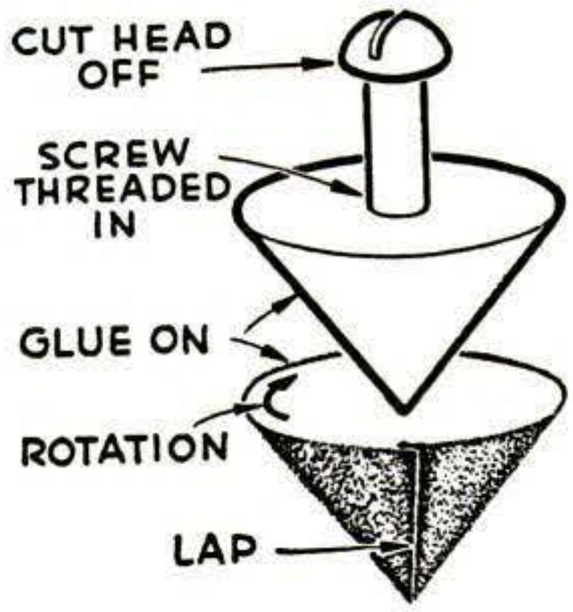
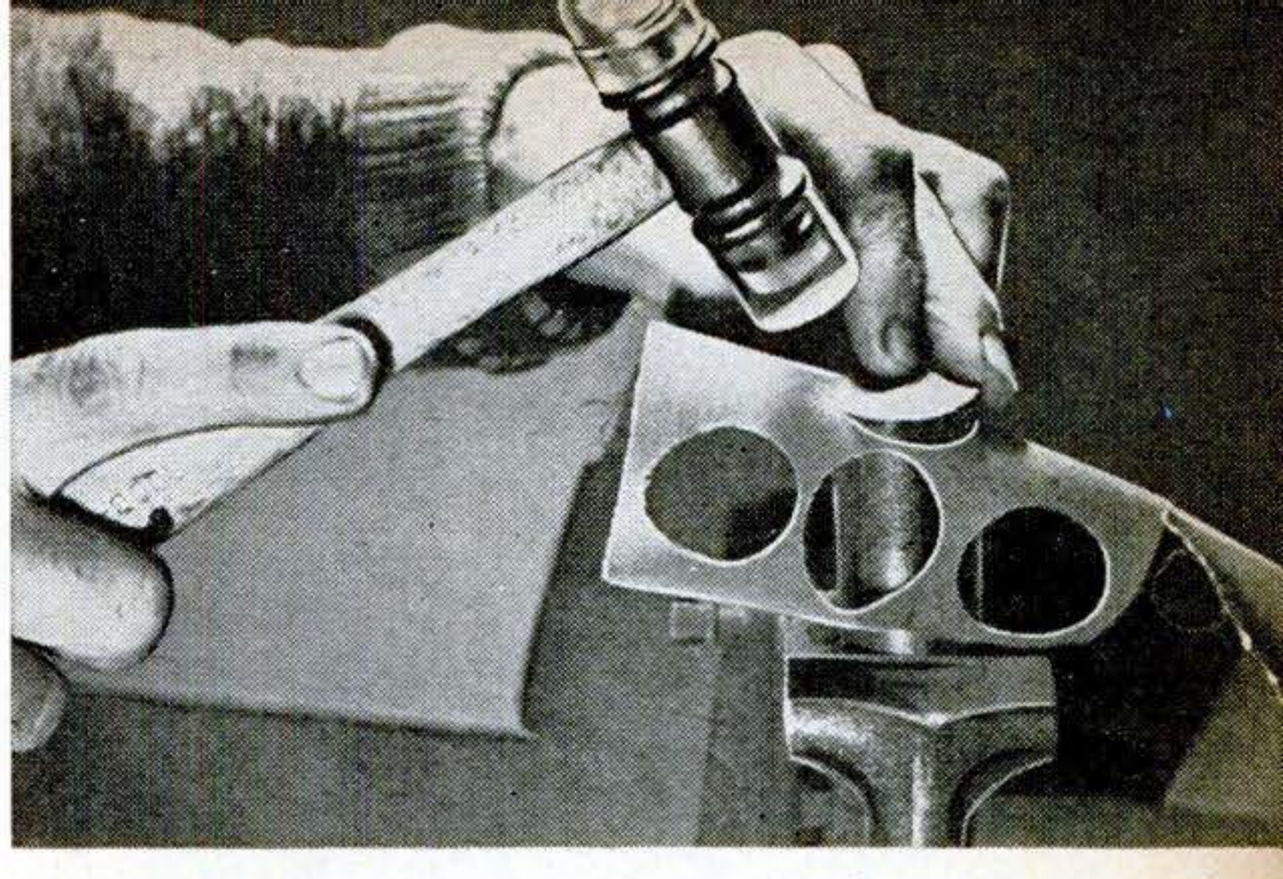
Layers of abrasive cloth stapled to a strip of wood form a handy "file." As the grit wears, a layer is removed.



Abrasive cones for a hand grinder are made by gluing to a cone-shaped drum.



Disks used on an arbor in an electric hand grinder are easily cut from regular abrasive sheet stock by hammering on the sharp edge of a steel rod of required diameter. Center holes are punched.

edges of holes and polishing inside diameters.

Stiffness varies with the number of mounted disks. Slots cut about halfway to the center increase flexibility when a disk is to enter a hole, or they may be omitted when the disk or disks are to burr the surface around a hole without entering. Disks of several diameters are assembled on an arbor in a shallow pyramid for some contours.

The disks for such assemblies can be cut quickly from sheet abrasive stock with a tool similar to a leather punch. When the quantity to be made does not warrant special tools, accurate disks can be cut by holding the stock, abrasive side out, against the end of a steel rod clamped in a vise and striking around the edge with a plastic hammer. The edge should, or course, be sharp enough to cut the abrasive sheet easily. Center holes for the arbor screw may be punched with a nail set while the disks are backed by a block of hardwood or soft metal.

Spot polishing or engineering finish, which once adorned the inside of fine watches and surfaces of instruments and machines, may be produced by an abrasive disk on a pad glued to the end of a rotating dowel. Leather or rubber from an old rubber heel is usually better than felt for the pad. The drill press is run at moderate speed for best results.

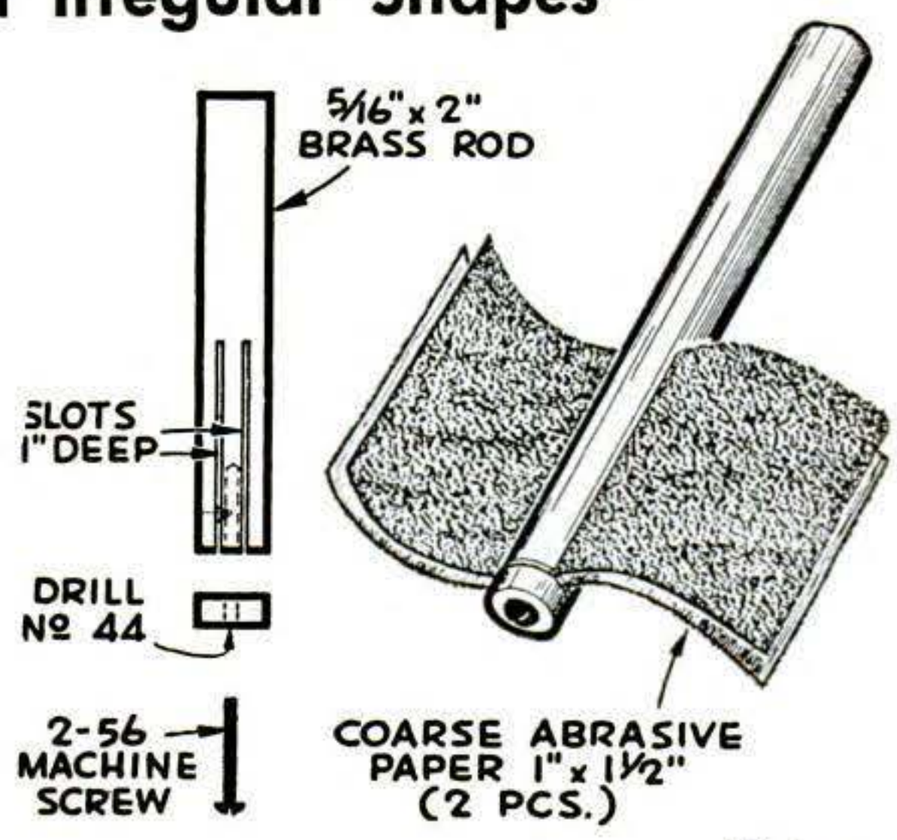
Strips of abrasive cloth coated on the back with glue and wound into rolls have many uses. When wound on a mandrel that is withdrawn, they have a center hole that will fit on a screw arbor in the chuck of a high-speed hand grinder or flexible shaft. A mandrel left in place while the glue sets becomes the arbor.

Rolls are made in various shapes. A strip of uniform width is used as a cylinder, or the roll may taper into a cone or bullet shape. As the outer layer wears down, the next is exposed for fresh cutting. END

Fly Sander for Inside Curves and Irregular Shapes

A NEAT, permanent holder for two strips of abrasive cloth or paper to be used in the drill press can be made from a 2″ length of ¼″ or 5/16″ brass or other metal. It will permit smoothing wood and metal without taking off much stock.

The retainer is turned off at the end of the rod after a No. 44 hole 1/16″ deep is drilled while the piece is chucked in the lathe. A No. 50 hole is next drilled in the rod and tapped for a 2-56 machine screw about ½″ long. Then the rod is removed, and two slots 1″ long are sawed alongside the tapped hole. Abrasive strips are inserted back to back in the slots.



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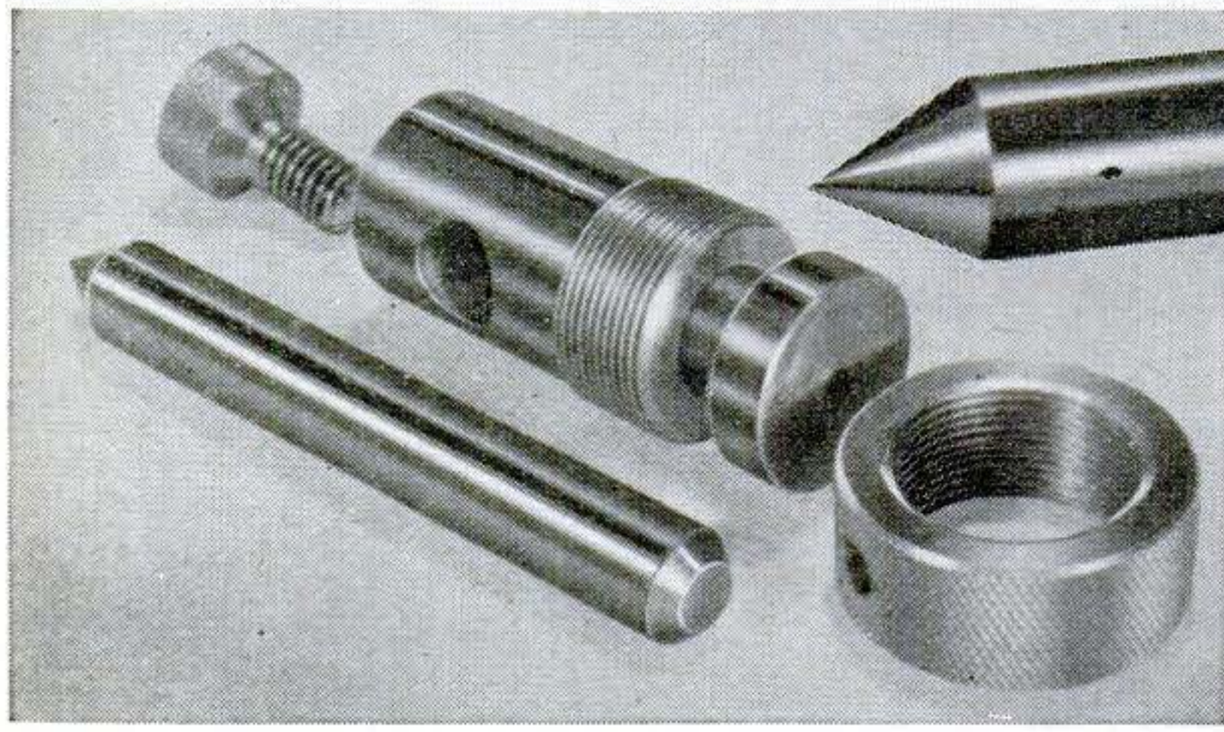
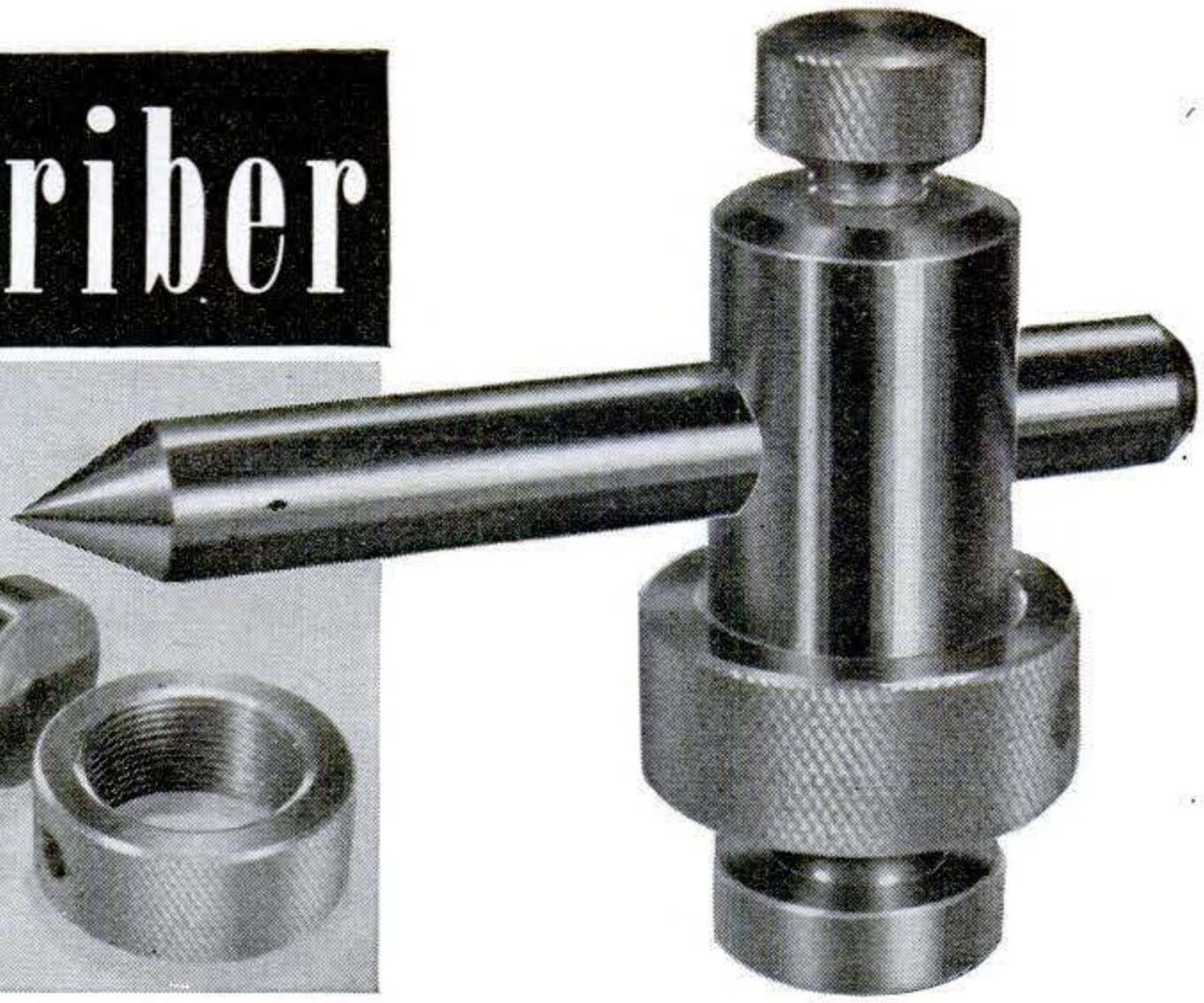
Lathe Scriber



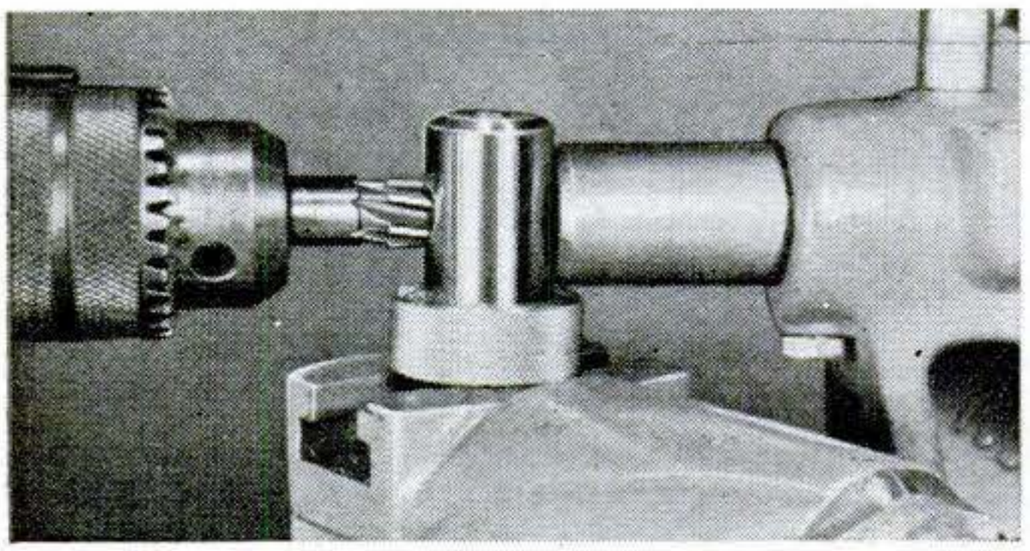


WHEN its post is mounted on the lathe compound rest, this combination scriber and punch is automatically set for work; the point is always at the exact lathe centerline regardless of the direction it is pointing. This is of particular advantage when work is being indexed and the position of the layout tool has to be changed.

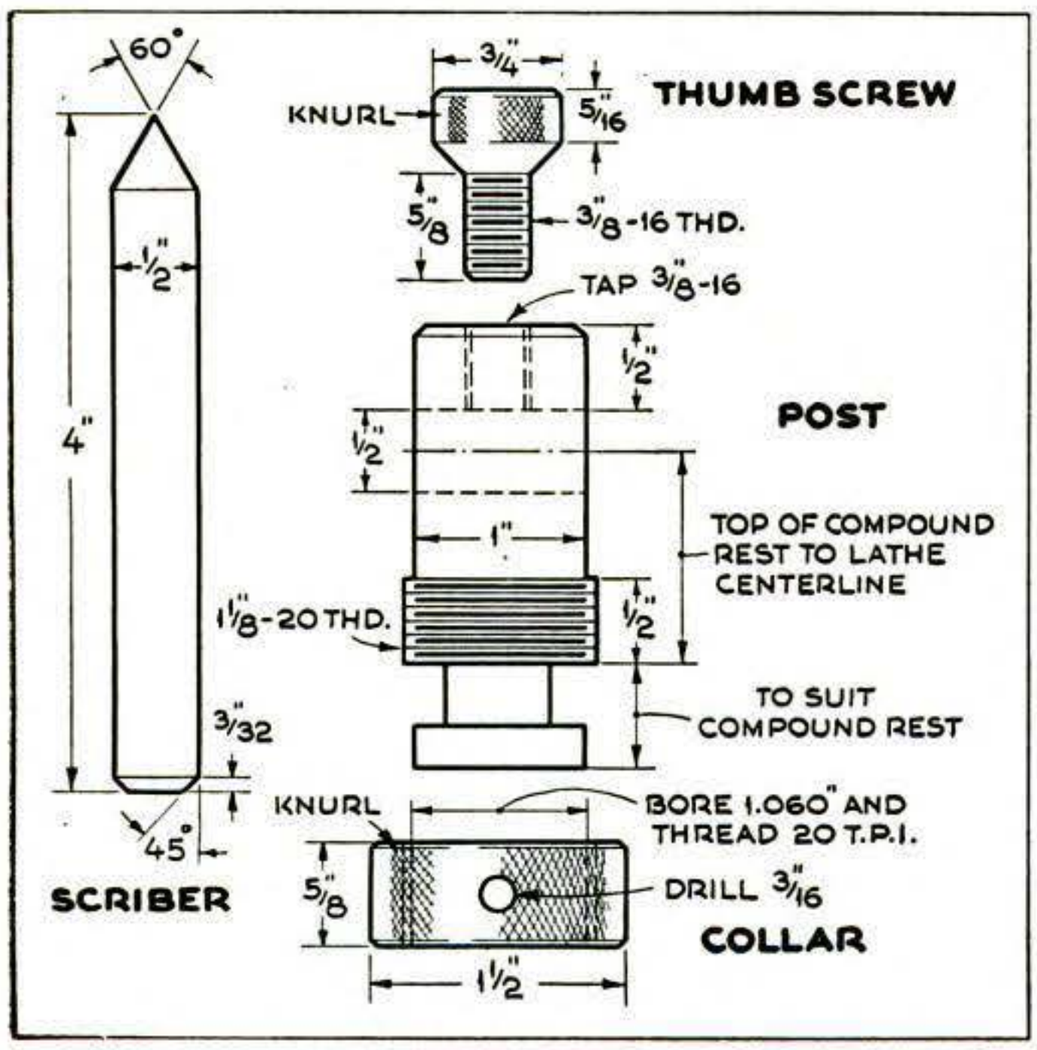
There are only four parts to the scriber tool—the post, collar, and thumbscrew, all turned from cold-rolled steel, and the combination scriber and punch, which is made from tool steel with a 60-deg. point. For best results, harden this part and grind the point.

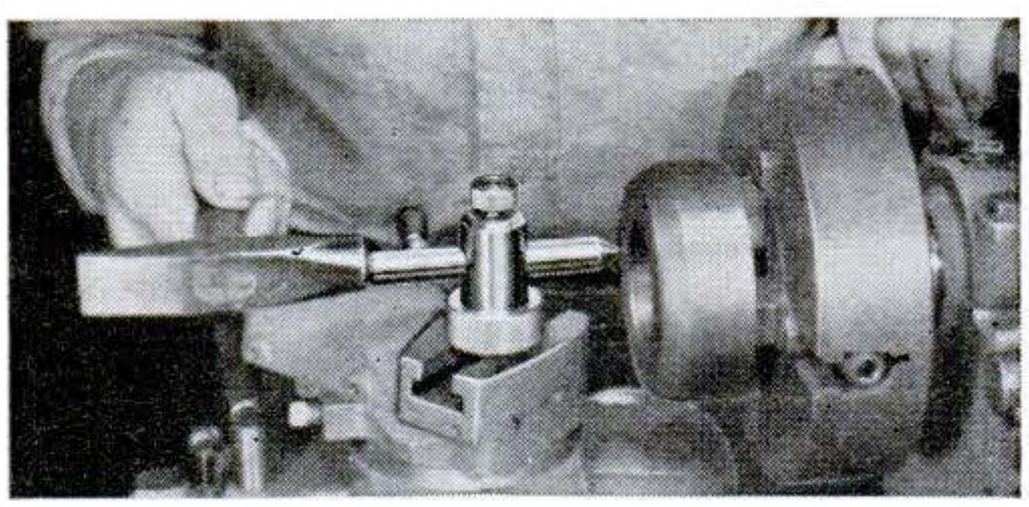
The thumbscrew and collar are knurled and threaded to fit corresponding threads on the post, which is turned to slide in the compound-rest slot. A 3/16″ hole is drilled in the side of the collar to take a spanner wrench, but the collar can usually be tightened sufficiently without the wrench when the tool is used as a punch. Accurate alignment of the transverse hole in the post is assured by drilling and reaming it while the post is held in the compound rest.

In use, the thumbscrew is tightened on the tool when scribing is to be done. For punching and indexing, the thumbscrew is, of course, loosened.—JOHN A. BATES.



Reaming the tool hole with the post held in the compound rest. This assures accurate alignment.





In indexing, the tool is brought against the work, the screw loosened, and the punch struck sharply.

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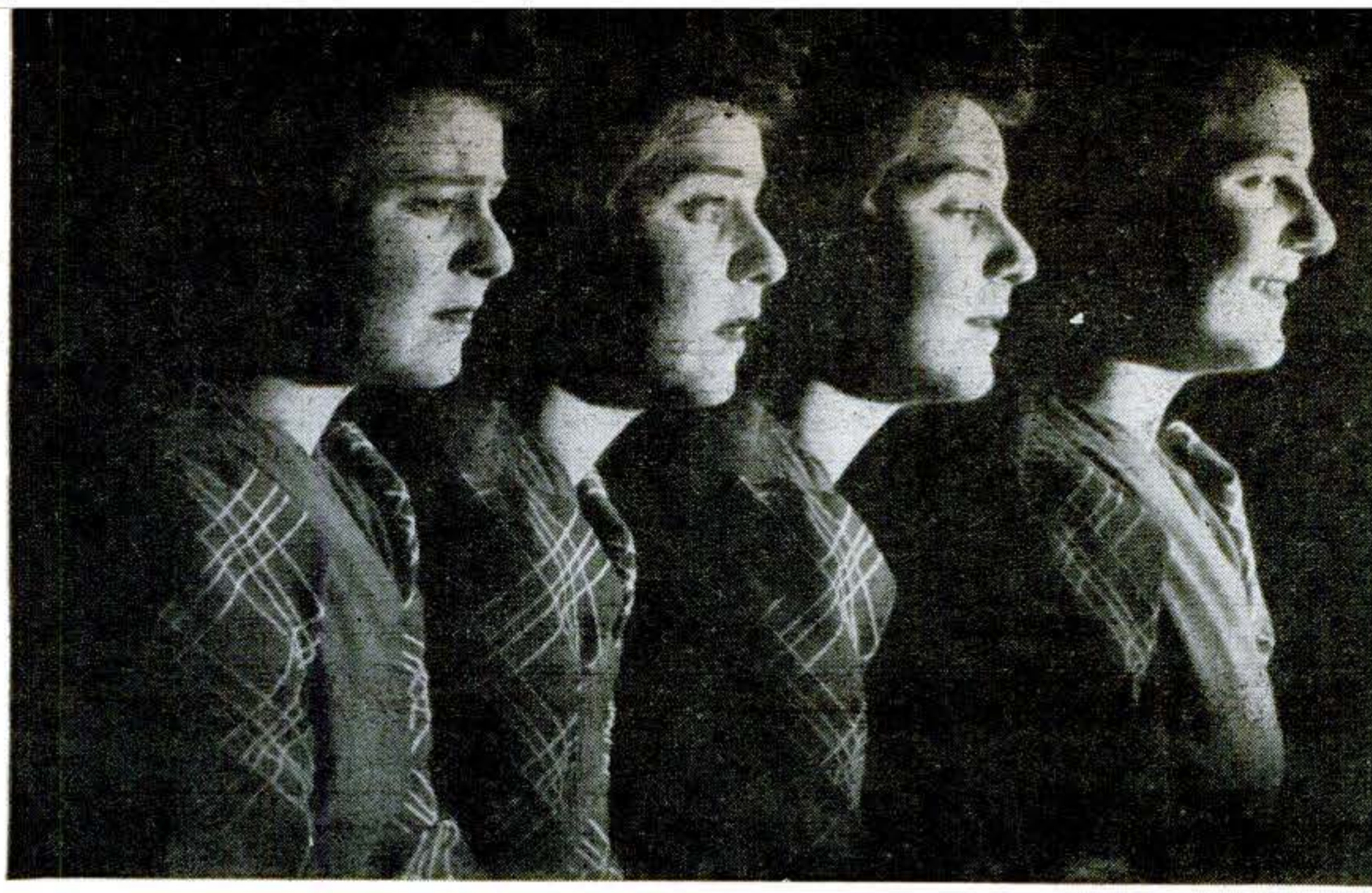
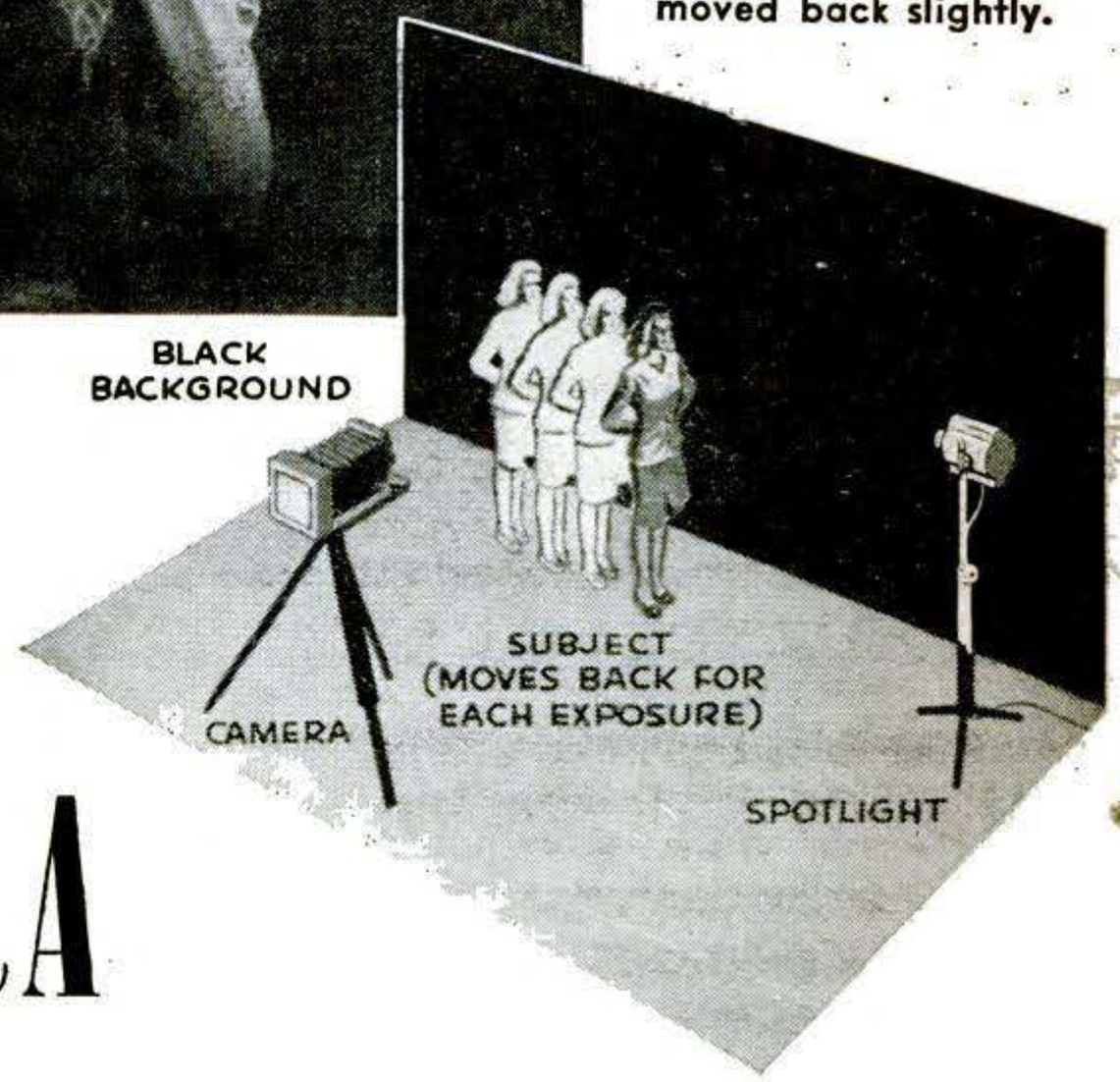


Quadruplets? No, just one girl photographed four times on a single film. A spotlight, a black background, and judicious framing did the job. After every exposure, the girl was moved back slightly.



Black Magic with a CAMERA

By LOUIS HOCHMAN

GHOSTS, giants, pygmies, and many other fantastic and unreal things all exist in the realm of photographic black magic—magic that is made possible by a dull black drape tacked on any convenient wall as a background. The trick photos that can be achieved with this simple prop are almost countless. Symbolic interpretations of moods, emotions, and personalities, montages, and such weird effects as human beings walking on clouds are just a few of the many interesting possibilities.

Such backgrounds make an asset of the fact that black absorbs light. What little light it may reflect is negligible photographically. Therefore, since photographic emulsions depend

Walking on clouds is easy—the double exposure way. Cotton first was photographed close up, then the girl at a distance.

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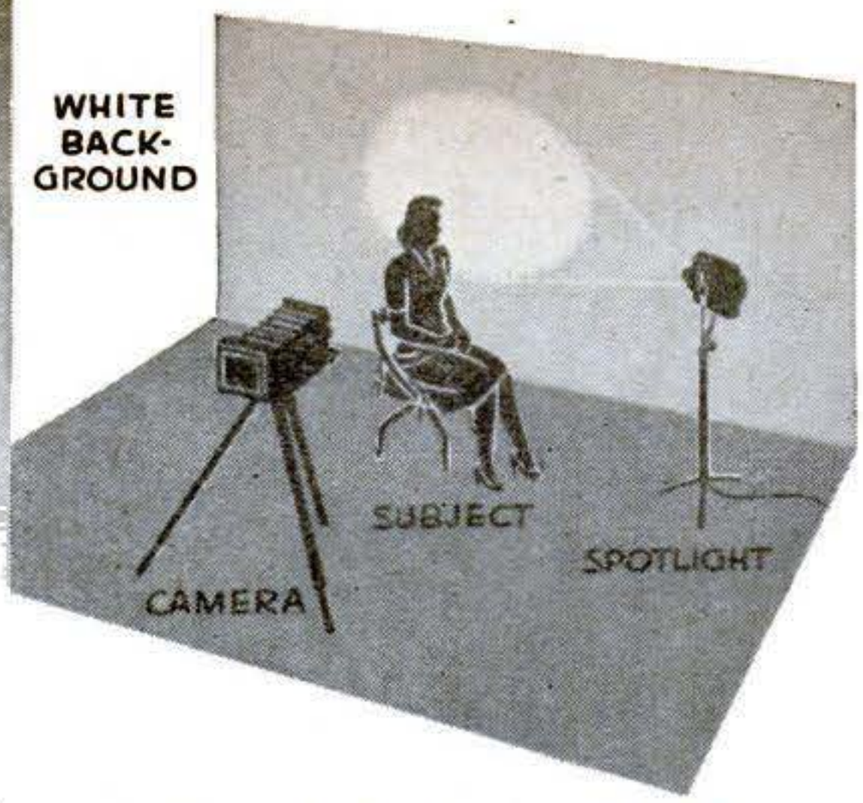

1 For this study, a model first was silhouetted by throwing a single spot on a white background and then making a short exposure.

on reflected light for their images, nothing will register on a film when you focus on a black background.

As an example, suppose you pose a person against black, framing him in the finder so that the image occupies the left half of the film. If you develop the film at this point after making an exposure, the resultant negative will show only the image of the model—with the rest of the film remaining clear because the background has not registered. Actually, the right half of the film remained unexposed and could have been used to record another image if care were used to prevent it from overlapping the first. By the same token, three or more separate images can be taken on a single film with skillful framing.

Take advantage of this fundamental principle, and you can produce many unusual effects. An easy one for a starter is a photo like the one at the top of page 185—a model photographed four times on the same film, each time registering a different emotion. In these effects, lighting is an important factor. Its full strength must be directed only on those portions of the subject that you want to record, the remaining areas being allowed to fall into deep shadow that will blend into the black background. Spotlights offer the best means of obtaining such controlled lighting.

In this particular photo, a single spotlight was used to illuminate the front of the model. After each exposure, she moved back and another exposure was made. More accurate framing can be achieved by tracing the position of the image on the ground glass for each exposure. In this way, you can see exactly where each picture was taken, and, after the last exposure has been made, the tracings will give you a fair idea of the composition as a whole.

This formula of multiple exposure can be varied by moving your camera toward or away from the subject to get successively larger or smaller images on the same film. This was done for the photo at the bottom of the next page, the model being backlighted with a single spot to high-light only her profile. The small image was taken first. For each succeeding image the camera then was moved forward a little more and the image framed so as not to overlap.

By careful control of your lighting you can even permit your images to overlap slightly without producing any undesirable ghost effect. This is particularly useful if

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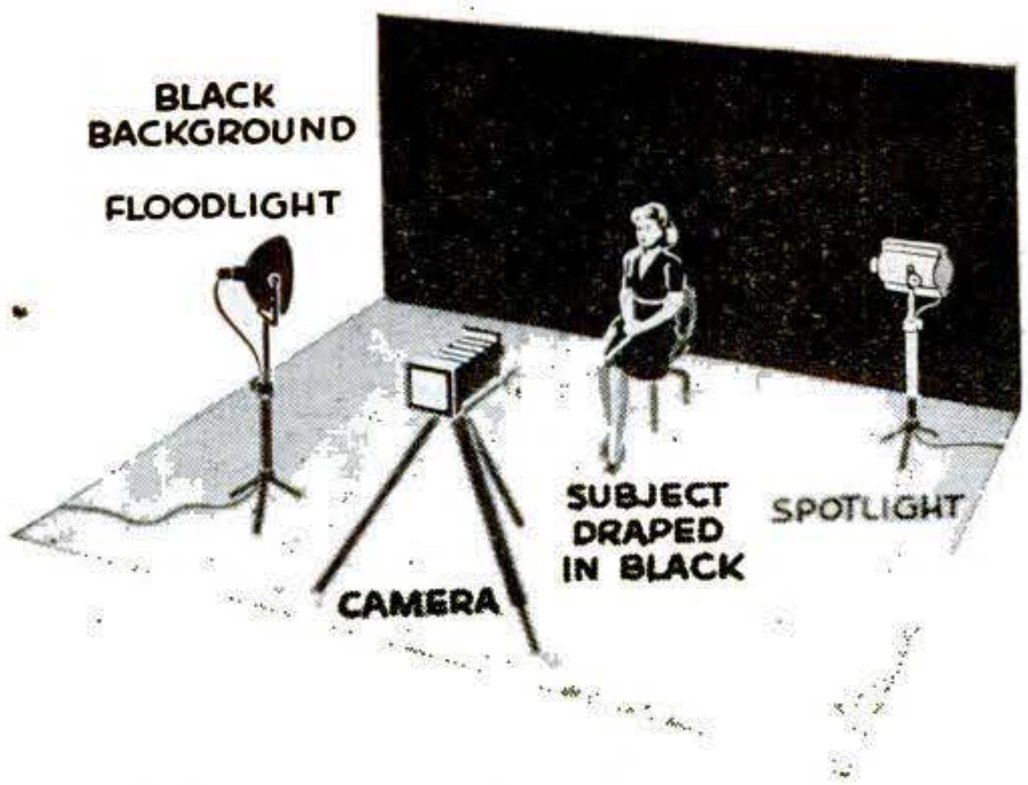
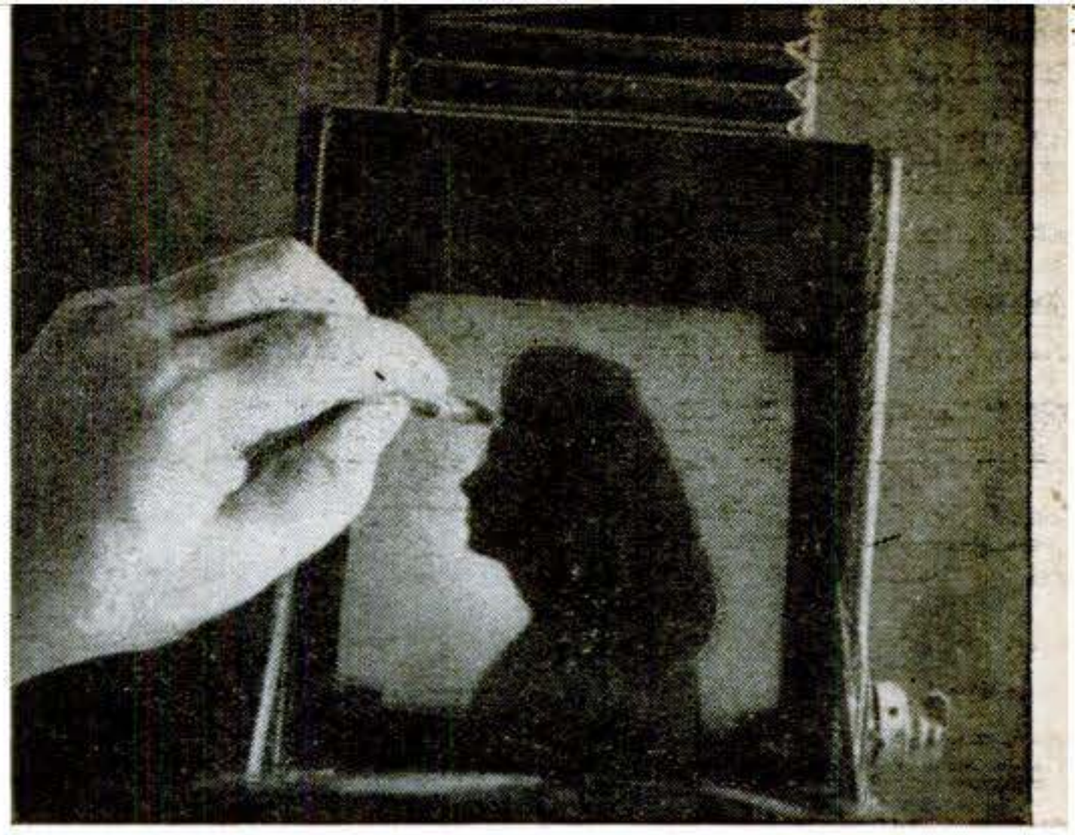


2 For the portrait within the black silhouette, the distance from the camera to the model was increased, and the model, draped in black, then was photographed against a dull black background.



3 All photographs involving multiple exposures require careful framing to prevent undesirable overlapping. This can be avoided and composition improved by tracing each one on the ground glass.

you want one image to appear as though it is behind another. In such cases, edgelight your main figure strongly. Then, for the second exposure shade the light so that it trails off into darkness over the portions that overlap the edgelighted outline of the former exposure. The edgelighted outline will overpower and weakly lighted portions of the second exposure that happen to run into it.

However, if you do want a ghost effect, make certain that portions of the "ghost" overlap areas previously exposed. For true ghost pictures it is only necessary to pose the ghost subject against the black background after making the other exposure in a normal manner. The "ghost" will be more realistically transparent if framed against a dark portion of the original composition.

An interesting dual portrait variation of the black background theme appears on the facing page. Here, the black background was used for only one of the two exposures. The first, that of the silhouetted profile, was taken against a white background, a spotlight being directed against the background directly behind the model's head. To make sure that no detail in the features would register on the film, the exposure was kept short, being calculated only for the white wall. For the second exposure, that of the portrait within the profile, the model was posed against a black background and draped in a sheet of black material to prevent her lighter clothes from registering to the edge of the silhouette, where it would have spoiled the outline effect desired.

By juggling your proportions, you can photograph small objects in giant stature and use them as props for special effects. For instance, in the photo at the bottom of page 185 small masses of cotton were placed on a table, framed at the bottom of the film, and photographed from close range and slightly out of focus. A girl then was photographed at a greater distance to bring the image down in size and produce the effect of a girl walking on clouds.

These are just a few of the possibilities of a black background. Once you have mastered the technique, your imagination can be your guide. END.

Here the subject was backlighted and the camera distance decreased for each successive exposure.

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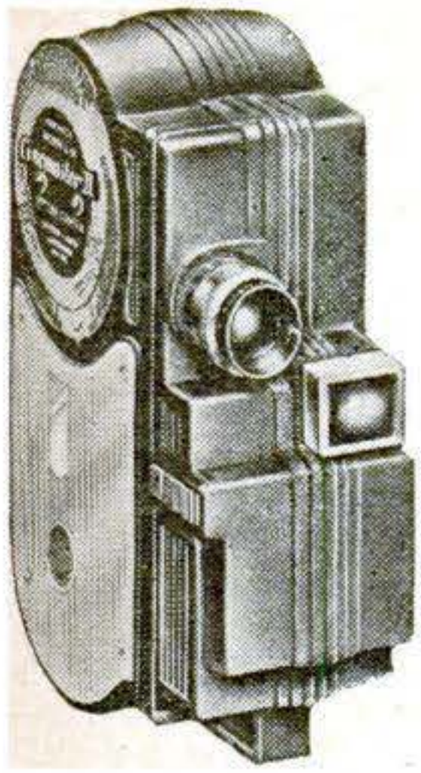
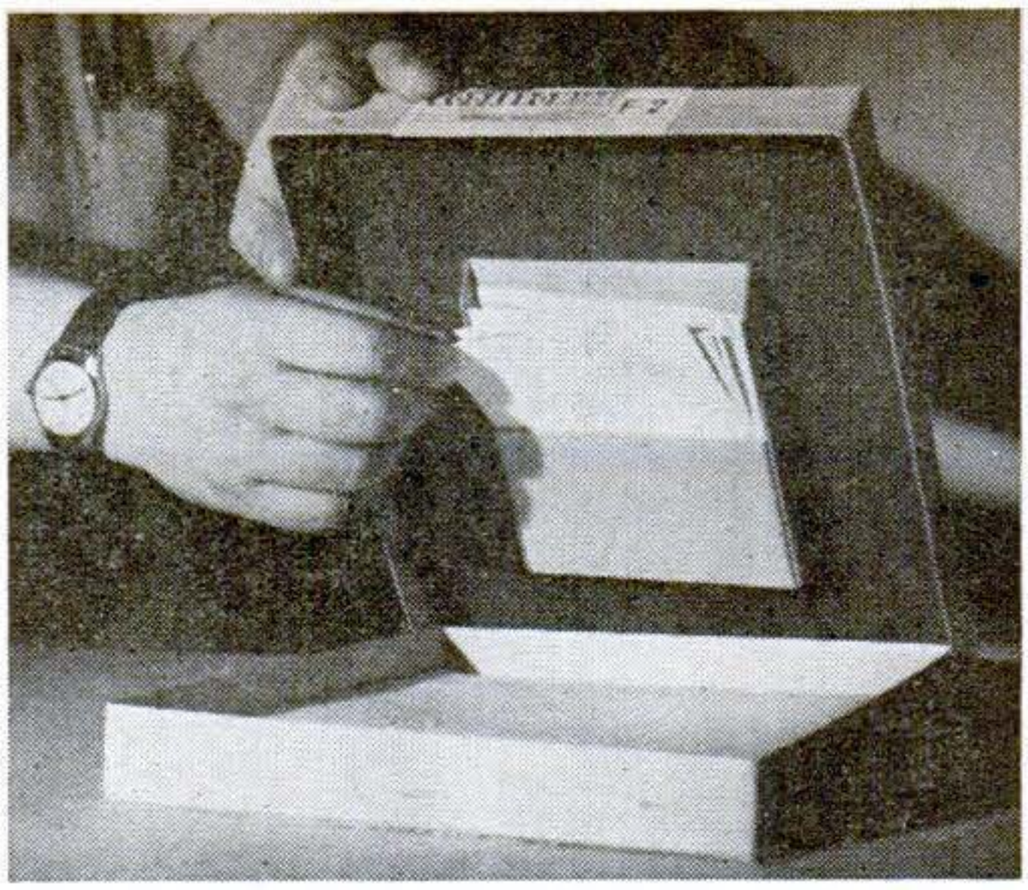
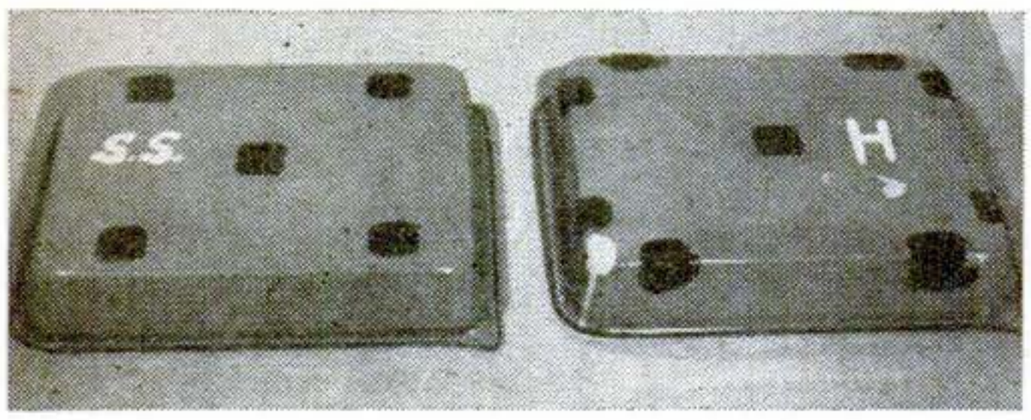
PHOTO IDEAS and EQUIPMENT



BUILT-IN METER. The new Universal Cinemaster II is on the market now with its own exposure meter built in. Designed for simplified operation, this movie camera uses double 8-mm. color or black-and-white film as well as single 8-mm. film. It has three running speeds and a choice of three lenses.



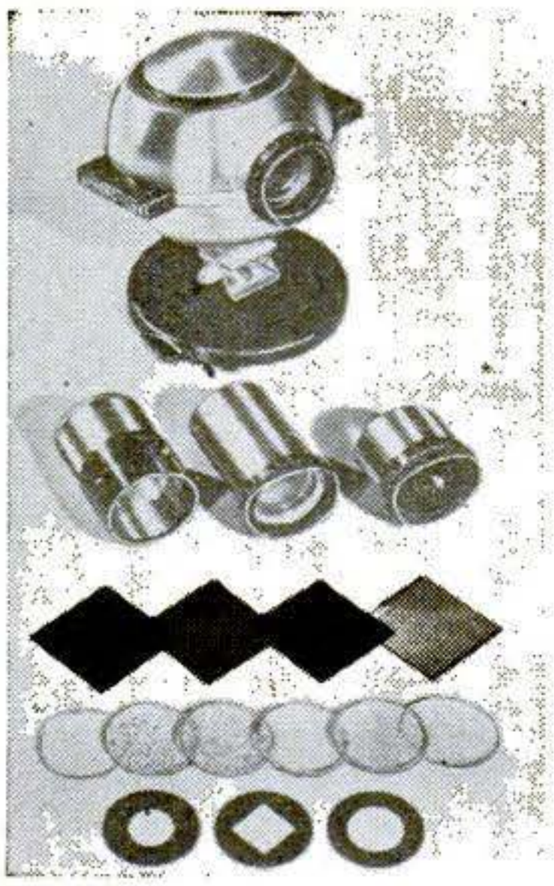
SMALL PAPERS IN LARGE BOX. One way of keeping 4″ by 5″ and 8″ by 10″ papers in the same box is to glue the inner cardboard container of a 4″ by 5″ cut-film box inside the cover of the 8″ by 10″ bromide-paper box. Then the small sheets can be kept out of the way when the 8″ by 10″ paper is being used and still be quickly accessible when needed.



CHIP PREVENTION FOR NESTED TRAYS. Ordinary inner-tube patches cemented to the bottom or bottom and sides of your enameled trays will keep them from chipping when they are nested for storage between use. Five patches will be sufficient for trays needing bottom protection only, or nine will protect both the sides and bottom. Either a rubber cement or gasket shellac will hold the patches securely.

CLAMP HANDLE. Clipped to a thermometer, a spring-type clothespin serves both as a handle and a stop to keep it from slipping into bottles or tanks when temperatures are being checked. The handle also keeps the thermometer from rolling off a table or shelf.

TRICK PHOTO LIGHTING. This special-effects lamp produces designs, clouds, lattice, and lines of light as well as spot and silhouette lighting. Floral, geometric, classic, modern, and color effects are possible. The lamp, a product of Jandor, Incorporated, of Chicago, is known as a Sphero-Lux photographic light. It comes in a floor and a table model. The latter is shown at right along with filters, design disks, and apertures.



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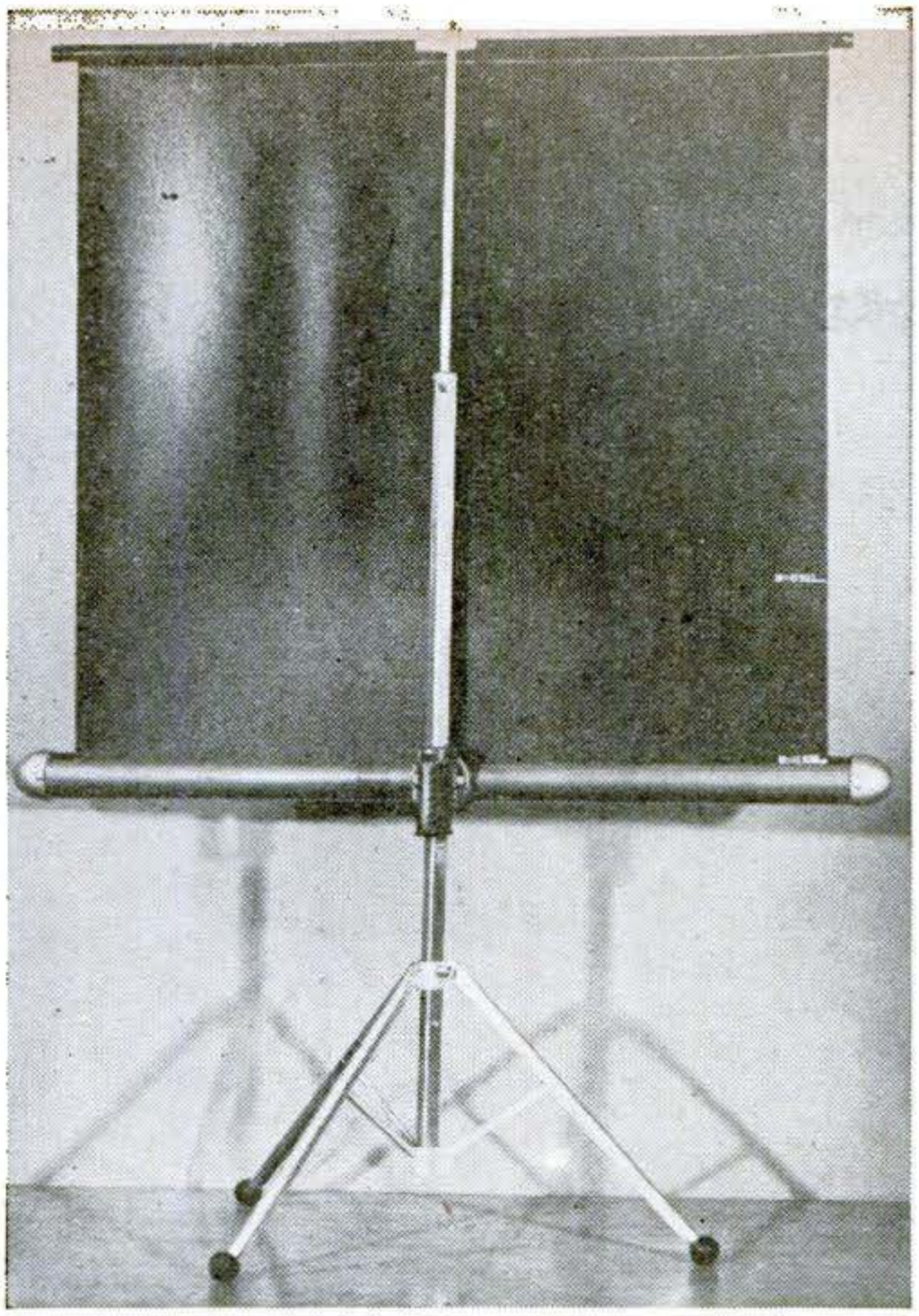
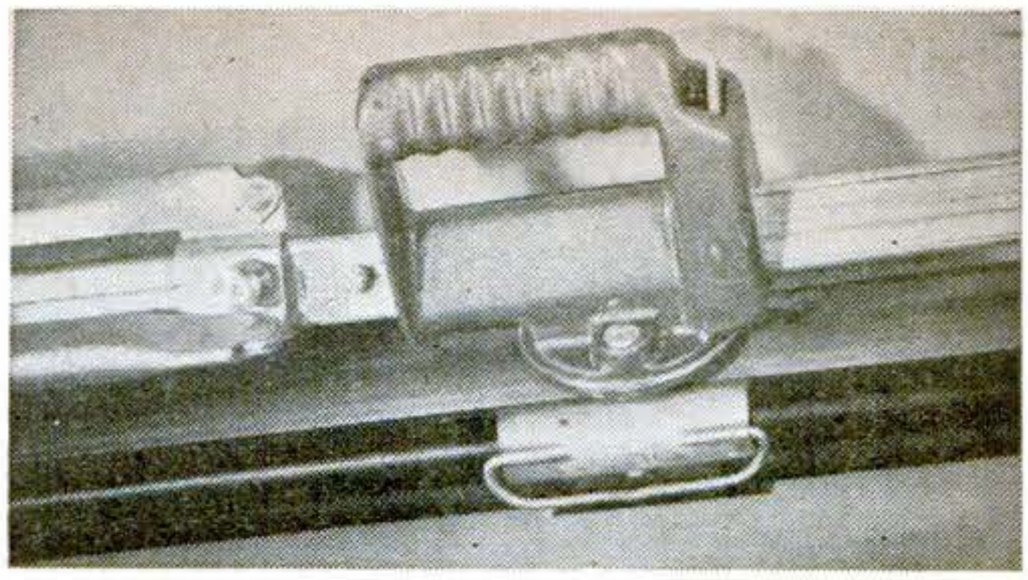
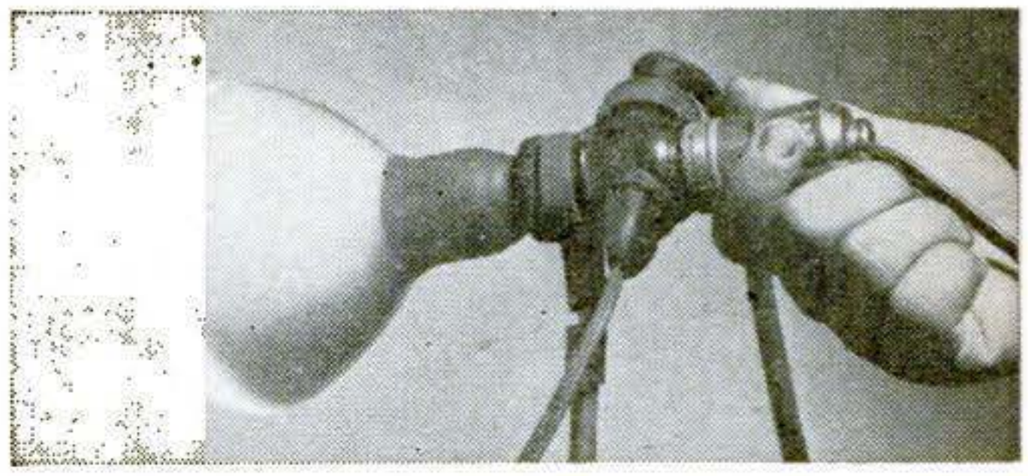


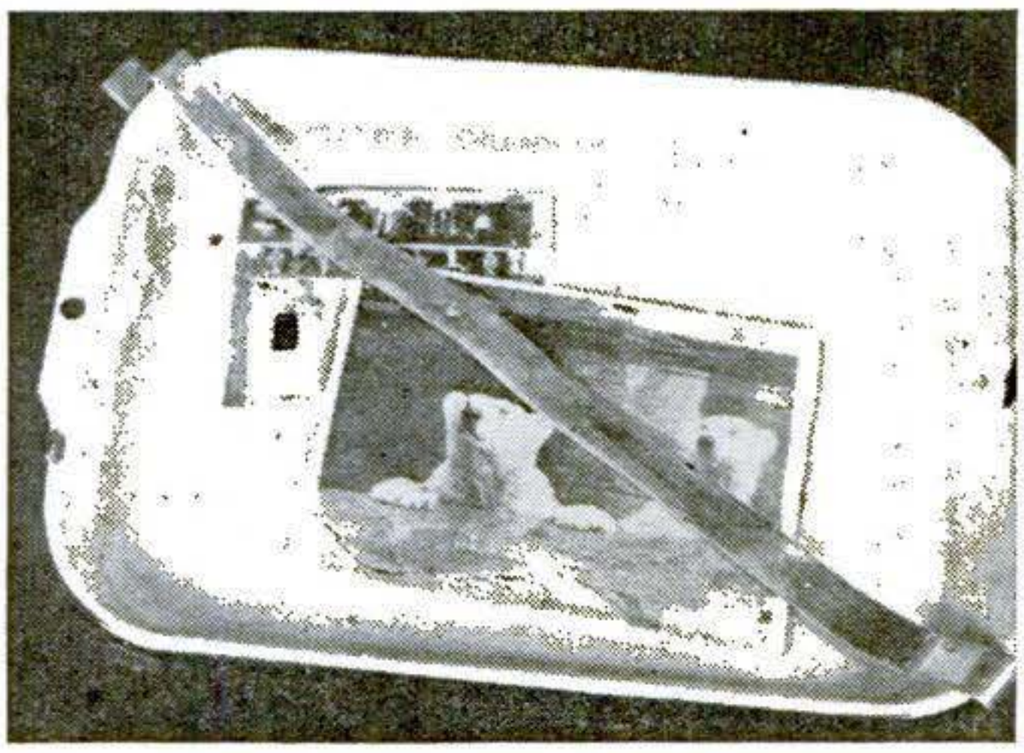


PORTABLE PROJECTION SCREEN. Automatic opening and locking of the tripod legs puts this portable screen into position quickly, after which the case is swung to the horizontal and a series of simple operations adjusts height, size, and shape for showing movies or slides. A balance attachment assures horizontal leveling on uneven floors. The height-adjustment device is incorporated in the carrying handle (above).

Known as the Radiant "DL," the screen is a product of the Radiant Manufacturing Corp., of Chicago. The screen proper has a glass-bead and plastic surface. It comes in sizes from 30″ by 40″ to 52″ by 70″.

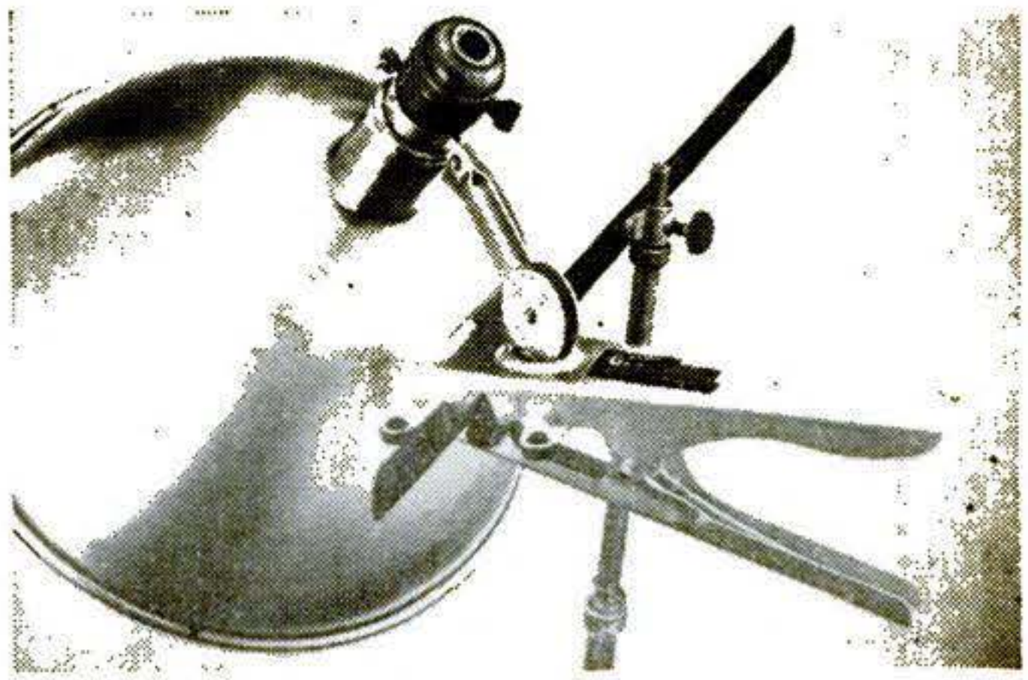
SIMPLIFIED LIGHT CONTROL. The use of a three-way light socket or plug will provide a single switch for turning on or off two or three lamps. The main lamp is screwed into the light socket, while extension cords to the auxiliary lamps are plugged into the outlets. Do not let the electrical load exceed the rating on the socket or plug.





HOLDING PRINTS UNDER. A length of stainless-steel molding, curved to fit below the level of the hypo solution and clamp on the edges of the tray, will keep prints from floating on top of the solution before they have been properly fixed.—HERMAN KLEIN.

CLIP-ON REFLECTOR CLAMP. A handy holder, this gadget can be clamped to a chair, door, table, or light stand, screwed on a tripod, hung on a nail in a wall, or made to serve itself as a miniature stand. The Gator Grip is made by Whitmore Products, of Pompton Lakes, N. J., and is under $3.



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Simple and convenient to use, this darkroom foot switch measures approximately 4" by 8".

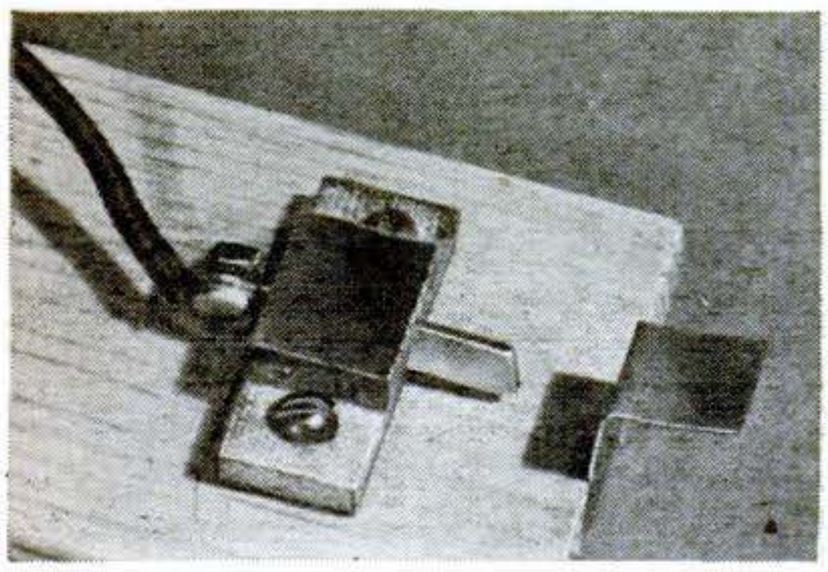
Enlarger Foot Switch

COSTING less than a dollar to build, this foot switch should prove a great convenience if you do much enlarging. The chief materials required are a few pieces of ¾" hardwood, a dime-store knife switch, and a stiff coil spring. A normally-off switch, it passes current as long as the pedal is depressed.

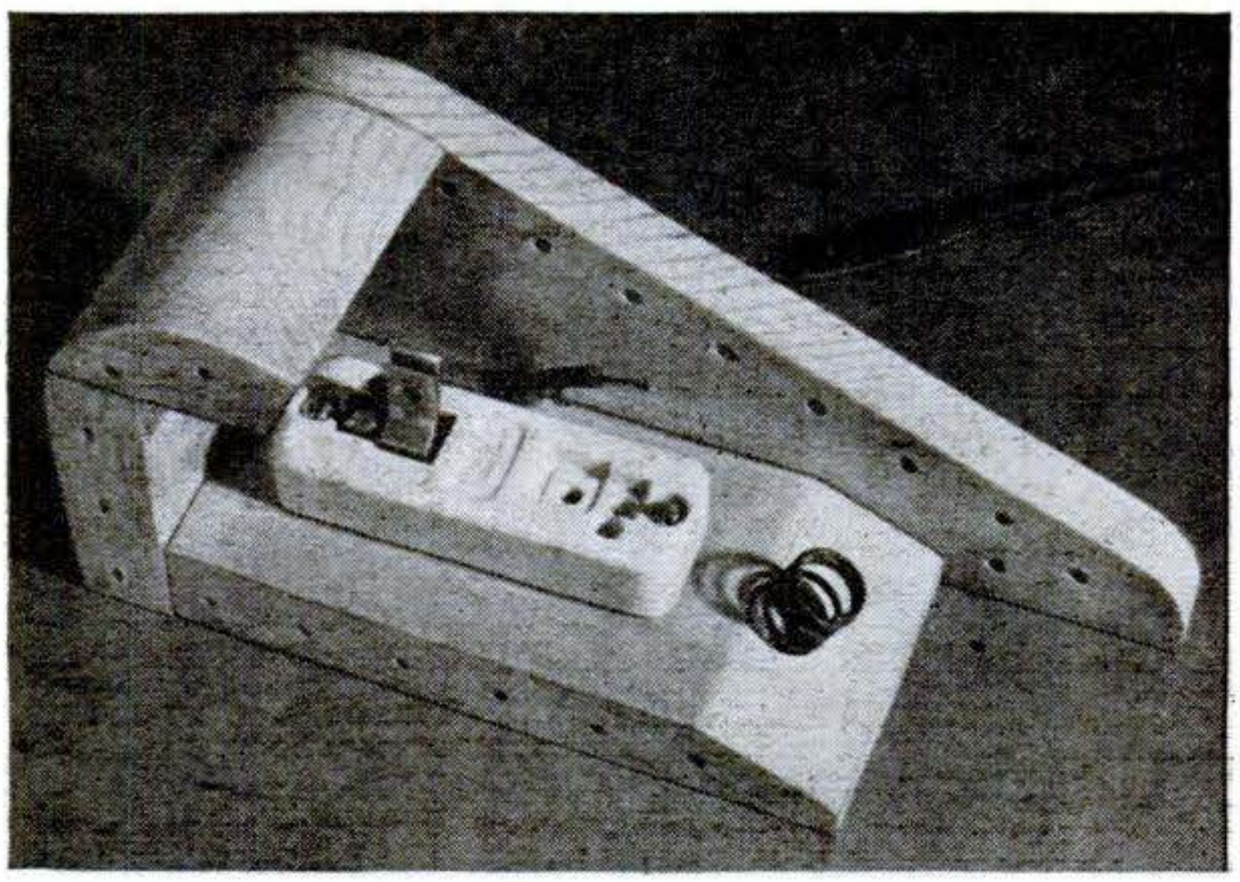
After shaping and sanding the six wooden pieces, cover the pedal with a piece of rubber stair tread. If desired, cheek pieces may be glued on each side and false screws inserted along the upper edges, as indicated, to improve the appearance.

Remove the blade from the knife switch, cut it to 1½" in length, and fasten, with small steel pins, in a saw slot in the upper side of a small fiber block. Screw this insulating block to the underside of the pedal, locating it so the knife will slip smoothly between the switch prongs when the pedal is depressed. Place the porcelain base so its end will stop the downward movement of the pedal at the point where the switch is closed. A metal stop keeps the pedal from rising too high. Use wire heavy enough to carry the enlarger-bulb current.

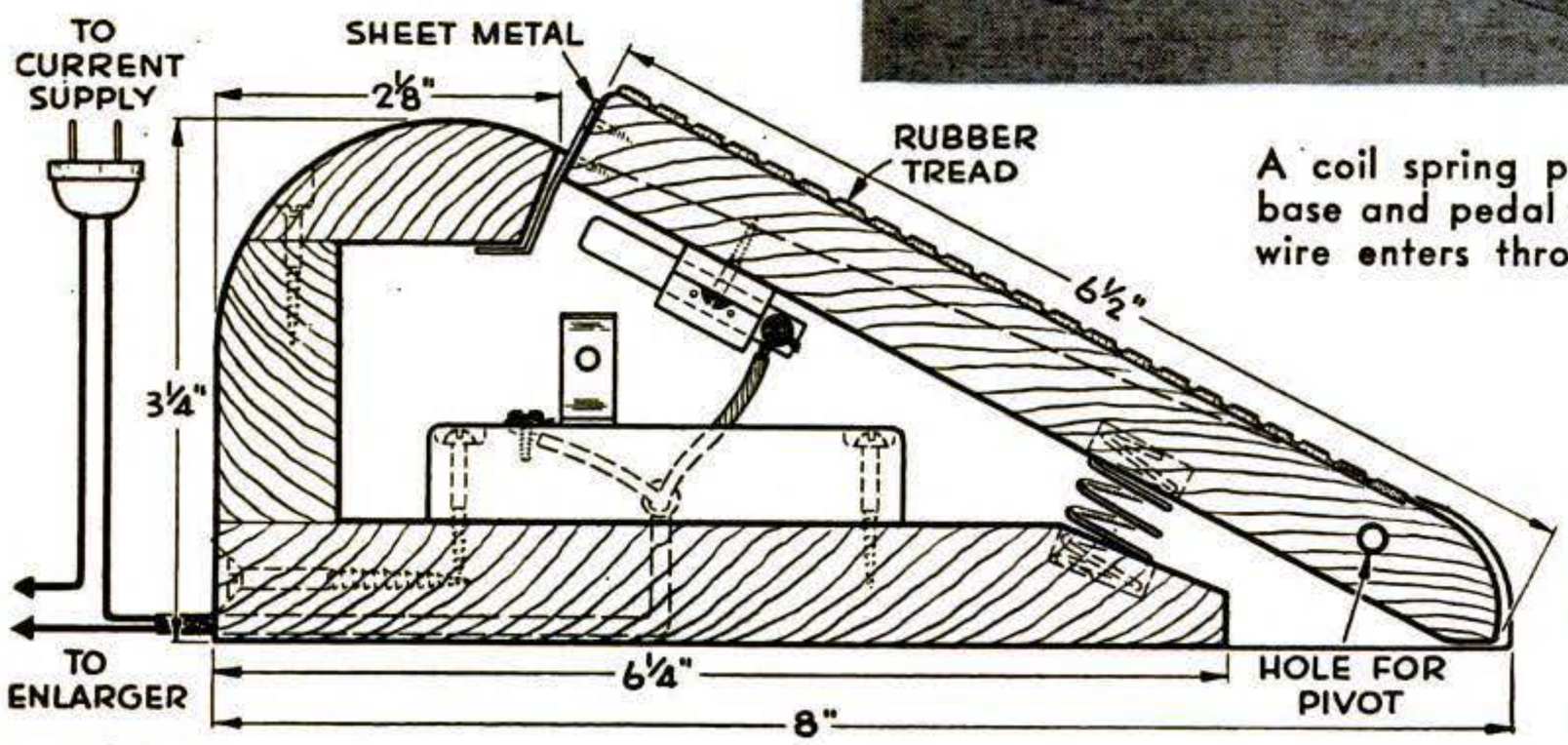
Paint the body dark and the pedal white or yellow (or use luminous paint). Cement a piece of rubber stair tread on the bottom to prevent skidding.—WILL THOMAS.



Pinned in an insulating block, the switch blade is mounted under the pedal. A metal stop limits the upswing of the pedal.



A coil spring pressed into holes in the base and pedal actuates the switch. The wire enters through a rubber grommet.



Place the porcelain base so that its forward edge limits the downswing of the pedal. Dotted lines on this sketch outline the sides of the switch.

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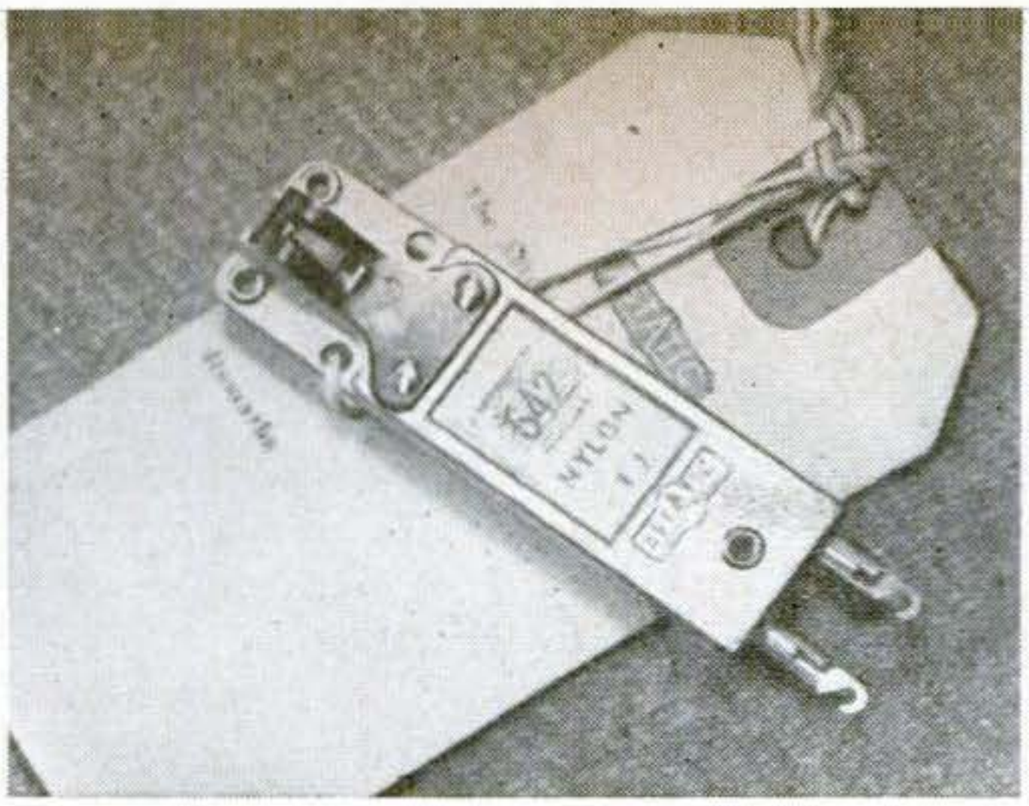
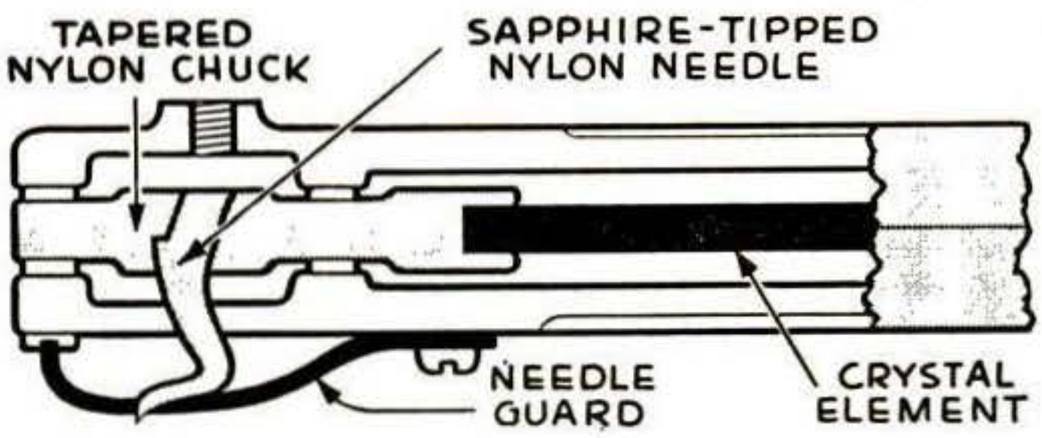
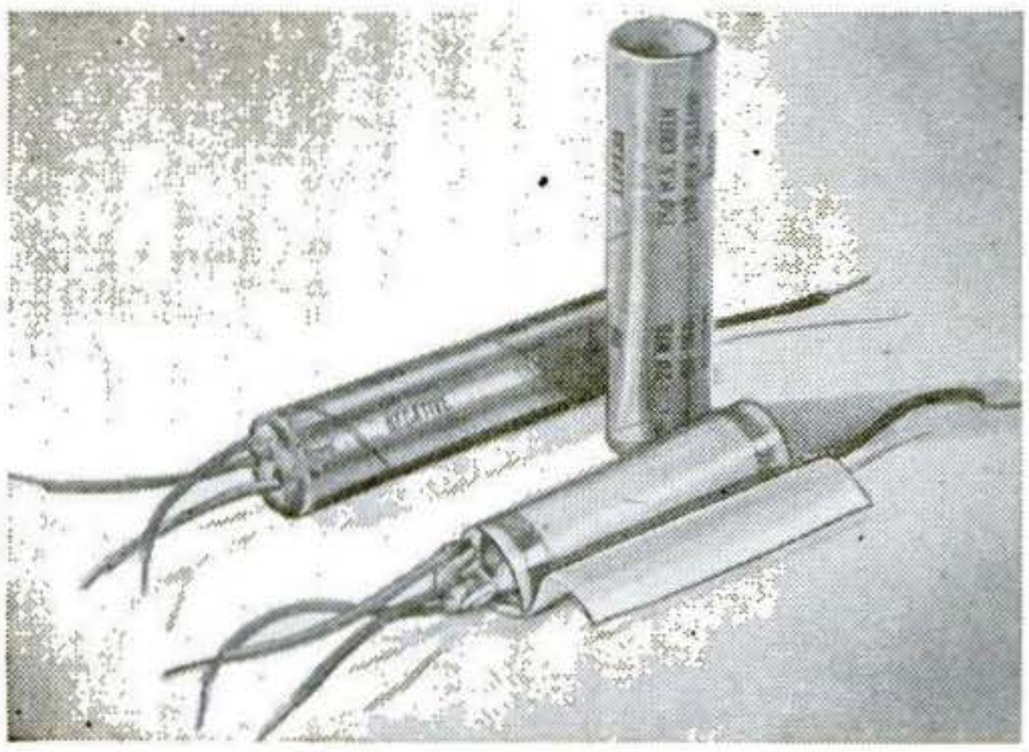




NYLON PICKUP CARTRIDGE. Solid nylon forms the needle chuck and sapphire-tipped needle of a low-pressure phonograph pickup produced by the Astatic Corp., of Conneaut, Ohio. As nylon weighs far less than any metal, the inertia of the moving parts is less and response is better. A guard cushions the needle and crystal against shocks. The pickup has an output of about 1 volt at 1,000 cycles.

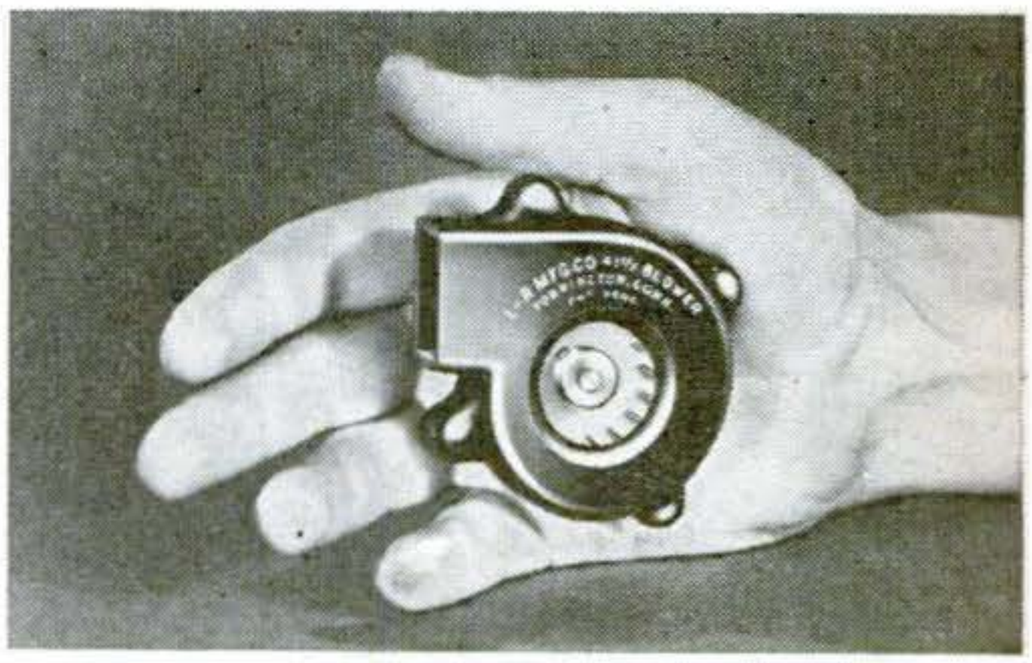
PLASTIC CONDENSER LINER. Longer life is promised for cardboard-tube dry electrolytic capacitors by a plastic film wrap fitted around the capacitor section before it is inserted in the cardboard. Developed for the Solar Manufacturing Corp., the plastic wrap takes the place of kraft paper. It retards evaporation, bars external moisture, and does not react with the electrolyte.



NEWS IN ELECTRONICS

R. F. PROBE. For tracing circuits, detecting power leaks, and the like, Radio Frequency Laboratories, Inc., Boonton, N. J., makes the R. F. probe shown at right. Its shape permits access to hard-to-reach spots. When the tip is exposed to an R. F. field, a proportionate current is induced, rectified, and indicated on the meter.

MIDGET BLOWER. Ham operators can cool transmitter tubes with molded plastic blowers, made by the Ripley Company, Torrington, Conn., so tiny they can be mounted on the transmitter chassis. The model shown is less than 3″ square, and its rotor is only 1½″ in diameter, but delivers a velocity of 2,000 feet a minute with a .0025-hp. motor.



SEALED CHOKE. R.F. chokes in hermetically sealed glass containers are produced by the Hanovia Chemical & Mfg. Co., of Newark, N. J. Rated to pass 125 ma., the chokes are available in five inductances from 1 to 10 millihenries.

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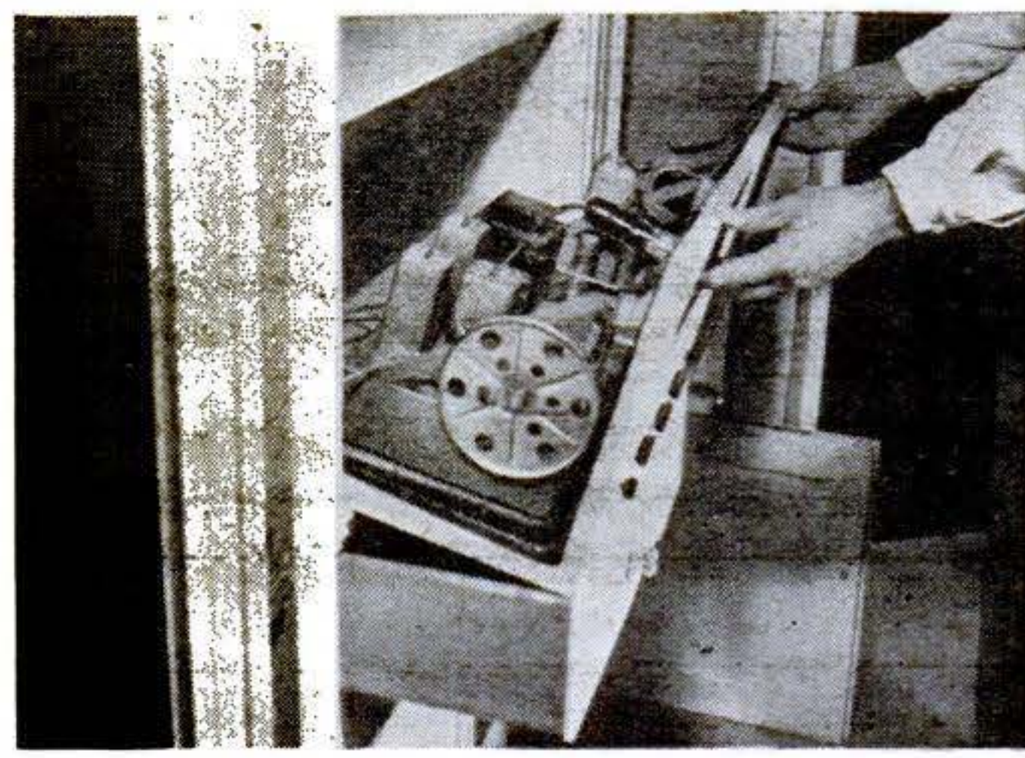
RADIO COMBINATION in a Wall Bookcase

By RICHARD B. LEWIS

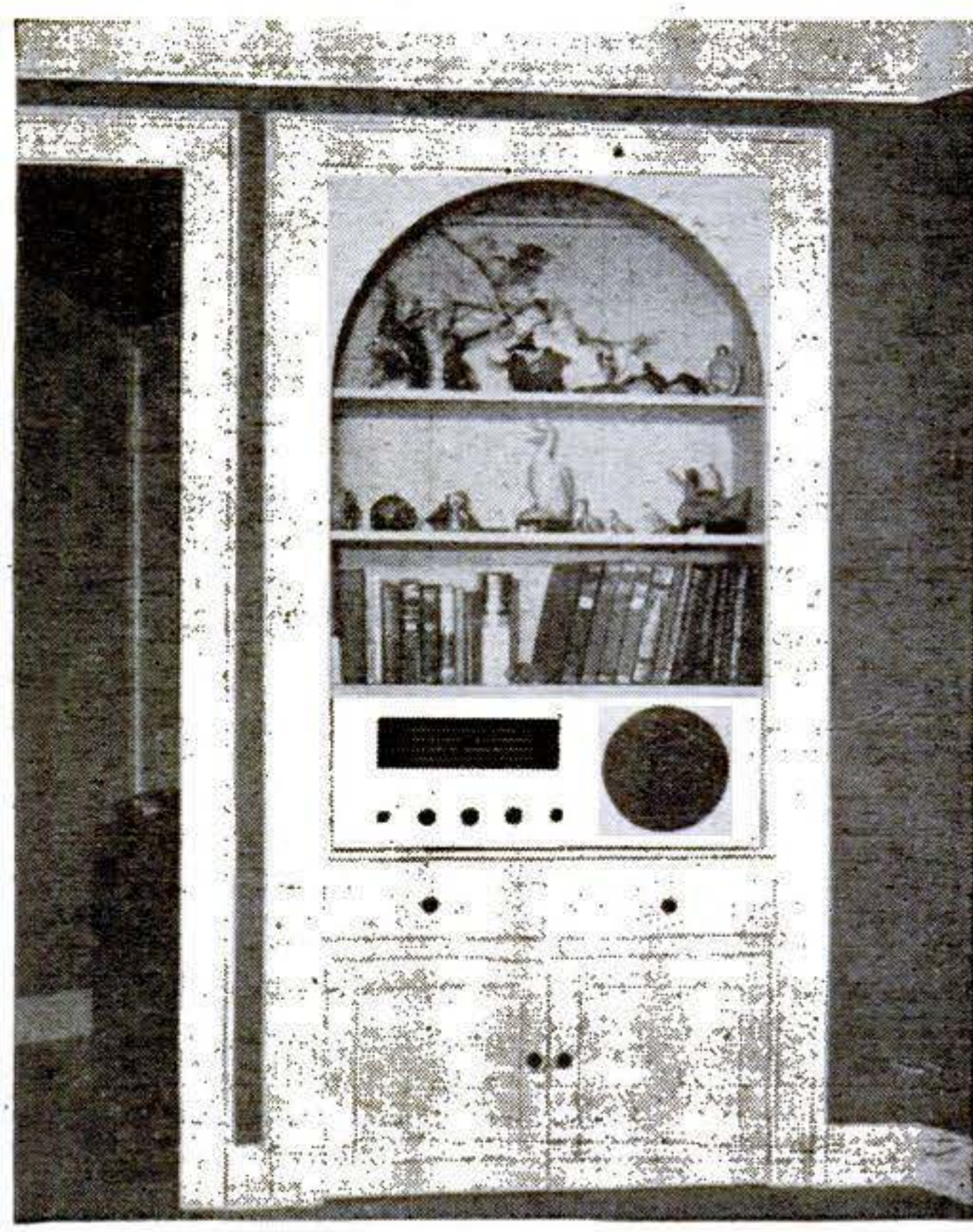
SOME record-player and radio combinations outlive the usefulness of their cabinets. If you have one that has become an eyesore or is so bulky that it takes up needed space in the living room, it can easily be converted into a built-in job. This is especially effective if you have a recess for book shelves, although the unit could be installed as well in a deep wall bookcase.

In the project illustrated, the living room had a recess that already contained a built-in bookcase consisting of a cabinet topped by two drawers and four shelves, as shown in the photo at left below. A panel was provided for the lowest shelf and jigsawed to take the radio dial and speaker. The record-changer and turntable unit was installed in one of the drawers. A power receptacle was wired into the wall behind the radio, and antenna and ground connections were also made there. Records are stored in the cabinet and on the shelves.

Because the record changer needed more depth than the drawer originally provided,



Tucked neatly away in a recessed bookcase, an old radio-phonograph combination is readily accessible and a modern piece. At left below, the bookcase before conversion; at right, after installation.



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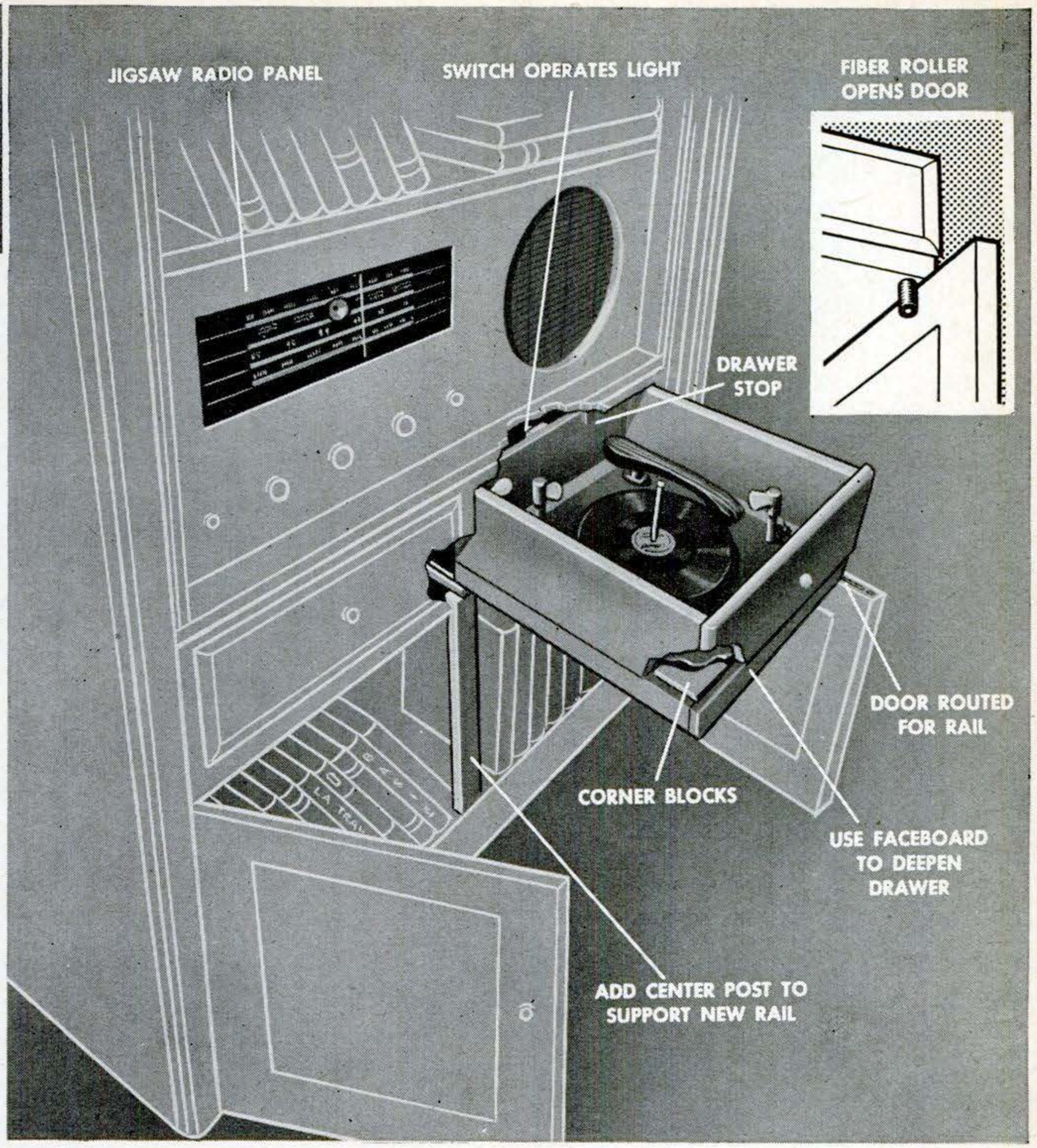

When records are to be put on the changer unit, the drawer is pulled open. It rides on a rail on one door.

the bottom of the drawer was lowered the necessary amount. Part of the old drawer rail was used as the extension in front to preserve a symmetrical appearance. A center post was added to support the drawer at the side away from the hinge jamb, and a stop was attached at the back of the drawer to keep it from being pulled out too far. The record changer was then mounted on corner blocks on the bottom of the drawer.

A steel rail of the type used in showcases was fastened in a groove routed in the top edge of the door that helps support the drawer, and the bottom edge of the drawer was well waxed so it would ride smoothly. This door is opened by a roller as the record changer is pulled out. A spring closes it.

To accommodate the radio chassis, a board was attached behind the panel with shelf brackets. This made a movable mount that could be pulled out from the bookcase for servicing the set. Wires for the radio and record changer were, of course, kept long enough to provide slack. Ventilation was cared for by a 3″ by 18″ slot at the back of the shelf just above the radio.

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Battery Phono-Radio Portable

Music where you like it with this spring-driven, battery-powered record player and receiver.

By WILLIAM NORTON

Built into a small carrying case, this one-tube radio-phonograph can be played anywhere. To suppress surface noises, close the lid while records are playing.

PORTABILITY in a radio-phonograph usually means little more than that the unit is built into a carrying case and provided with a handle. Such a set can be carried around easily enough, but can only be played where the right current is available. If you don't want to be tied down by the power lines, and are willing to sacrifice the convenience of an electric motor for the advantages of complete mobility, this one-tube combination will reward you by playing anywhere so long as it is supplied with batteries and you remember to wind its spring-driven turntable mo

The amplifier is a straightforward one-tube circuit in which the single tube—a 1D8 GT—acts as a two-stage amplifier. Output from the pickup or from a fixed crystal detector is fed into the grid of the triode section which is resistance-capacity coupled to the power pentode. A variable 250,000-ohm resistor between ground and the grid of the first audio stage acts as a volume control for both the phonograph and radio. Small as it is, the amplifier delivers enough power from the pickup to overload the 5" speaker.

Radio strength is not nearly as great, but local stations can be picked up with good loudspeaker volume. An external antenna and ground will usually be required for clear reception.

The primary winding of a standard shielded antenna coil is connected to the antenna post and inductively coupled to the secondary winding; capacitive coupling between the two coils is provided by C1, a 10-mmf. air-spaced trimmer. The combination of inductive and capacitive coupling increases selectivity without sacrificing volume.

For the tuning condenser, C2, a midget 360-mmf. variable capacitor was used. Small dimensions for this part are important if the condenser is to clear the speaker frame when the chassis is mounted in the cabinet.

The signal taken from the plate of the power pentode is matched to the speaker through a midget universal output trans-

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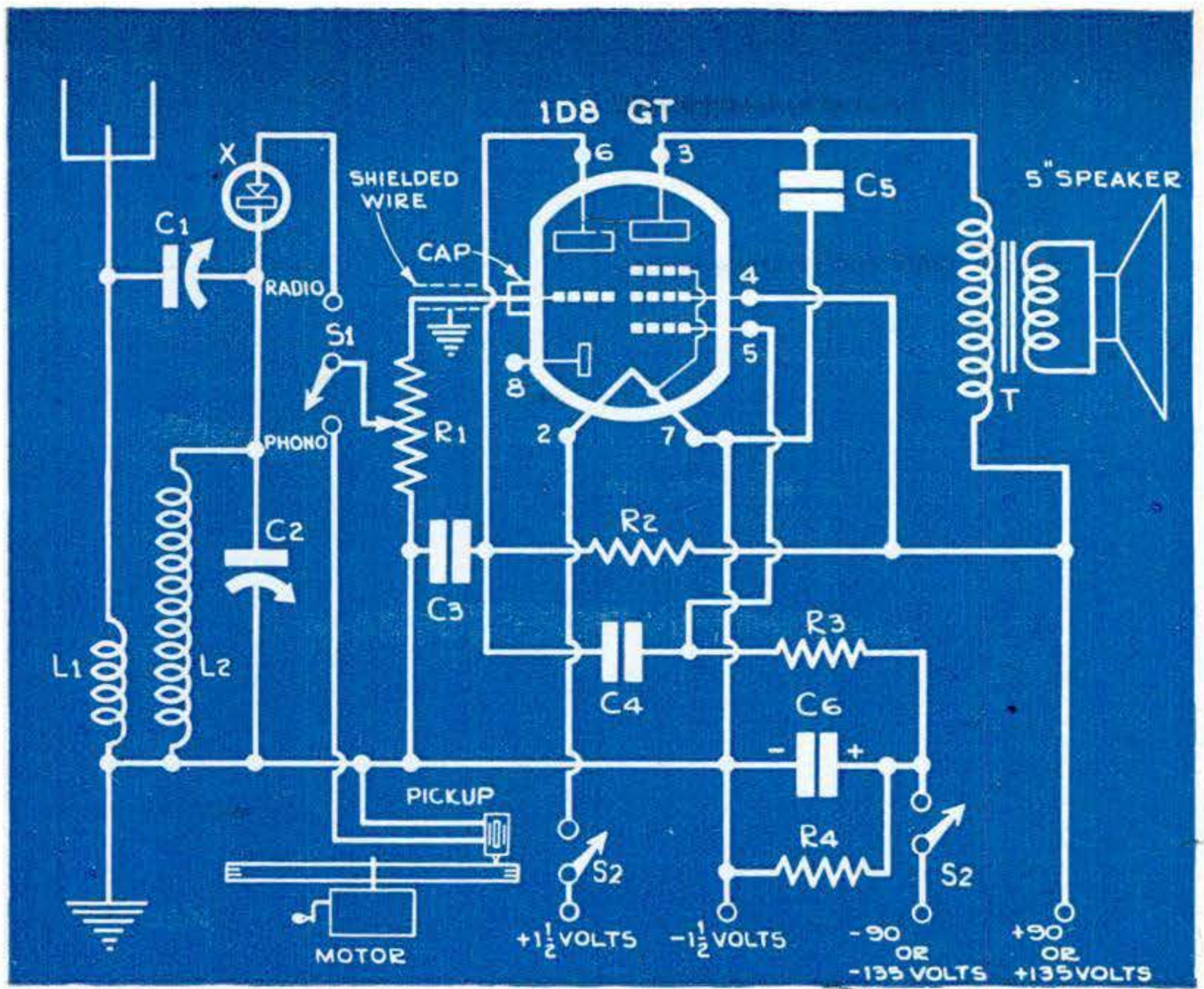
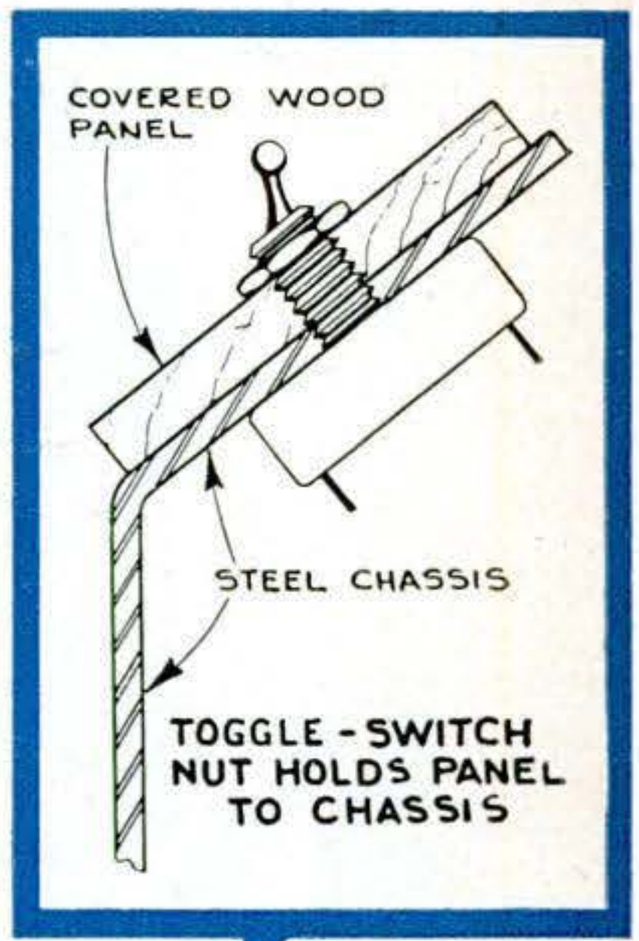
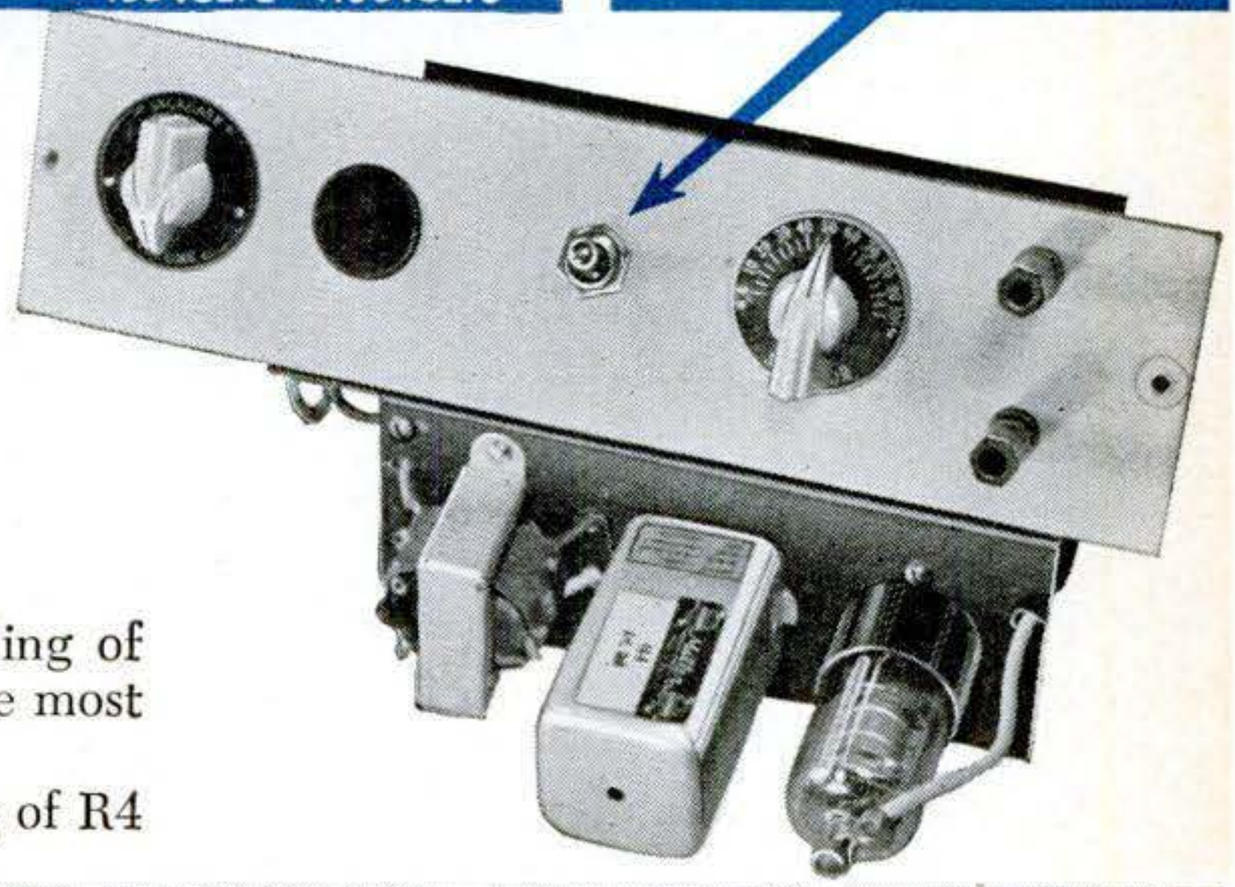


This one-tube circuit actually includes a two-stage amplifier fed either by the pickup or by the tuned circuit and detector. Parts are keyed to the list at the bottom of the next page.



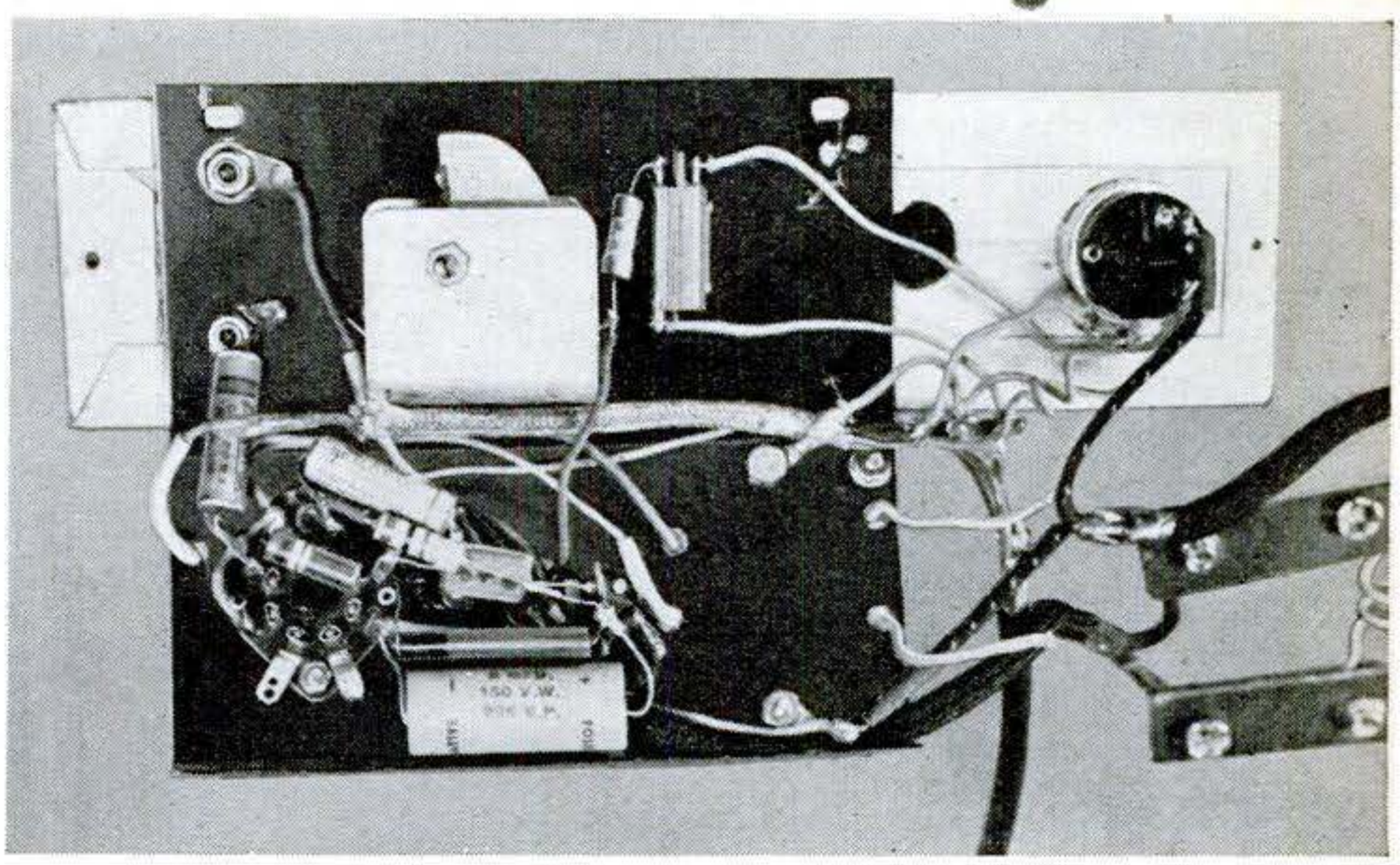


The chassis is a 6" by 6" metal sheet bent to conform with the slope of the wood panel. The cabinet is covered with artificial leather both inside and out.

former. Taps on the secondary winding of the transformer permit selection of the most pleasing tone.

An automatic bias circuit consisting of R4 and C6 makes it unnecessary to carry a separate "C" battery to bias the grid of the pentode. Bias voltage is taken from the drop across the 600-ohm resistor.

Two midget 67½-volt "B" batteries are connected in series to give a total of 135 plate volts, but anything from that down to 90 volts would serve. Higher plate voltage, of course, gives higher volume output, but for most purposes the lower voltage will be sufficient. A 1½-volt "A" battery supplies the



Wiring must be kept reasonably compact, but if small parts are used, no special crowding is necessary. Note the small 360-mmf. tuning condenser, and the miniature fixed crystal detector on its right.

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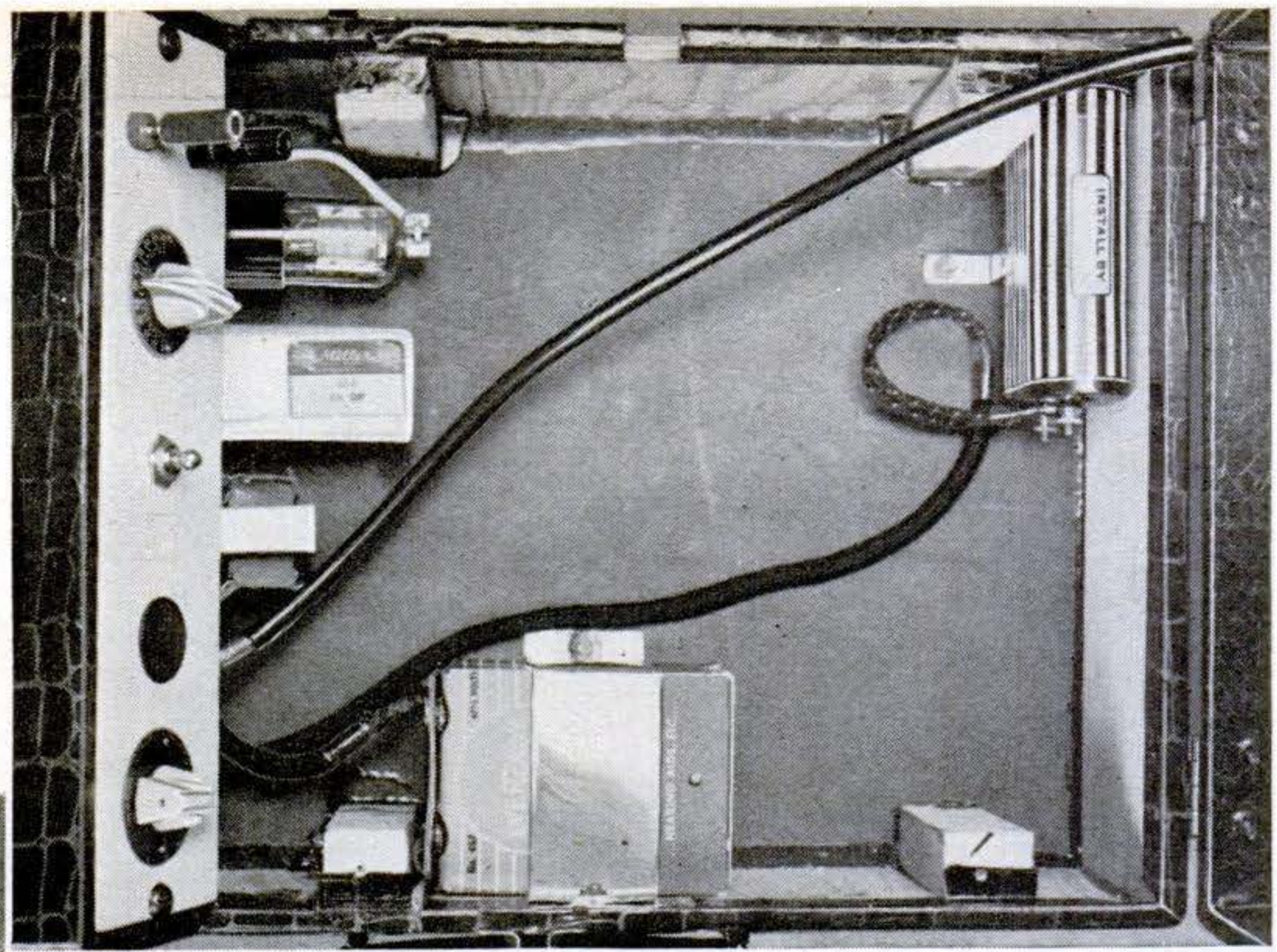
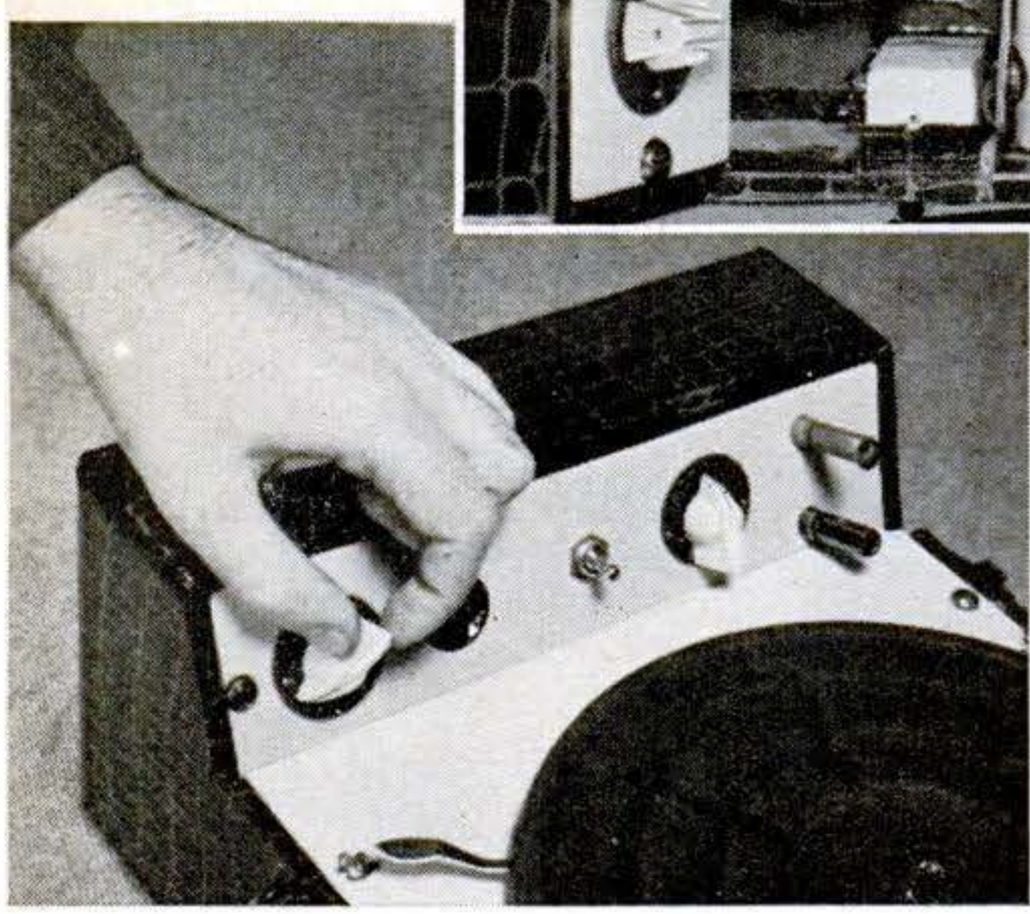
At right, an inside view of the case with the phonograph motor board removed. Note the position of the batteries, which are clamped clear of the motor.



The control panel is shown below in close up. The knob on the left governs R1 and S2, the volume control and switch. To keep from draining batteries, turn off the switch when the set is not in use.



tube's filament. The entire chassis is mounted on a 6″ by 6″ steel sheet which is bent to fit below and in front of the control panel. To mount the chassis to the panel, bolt the toggle switch through both pieces, as shown in the drawing on page 195. Follow the same procedure with the antenna and ground jacks.

Phonograph cases are now available in a wide selection of attractive luggage styles, and you can almost certainly find one to suit your taste and price. One factor that must be taken into account is the size of the records that you intend to play. Only 10″ records can be played on the model shown here, and a larger case will be needed if you want your combination to handle 12″ disks as well.

Single spring phonograph motors require about 50 turns for a full wind, and they will then play two 10″-record sides. Don't overwind the motor or use force in handling it. Bearings should be oiled occasionally, and the gear teeth lubricated with petroleum jelly about once a year.

If the motor has a speed regulator, set the pointer at 80, or midway between "S" and "F". Accurate adjustment of turntable speed may be made with stroboscopic record, but if you don't have one of these, insert a slip of paper between the turntable and a record so that it projects at one point. Then count the number of times the paper passes a given spot in a minute. Increase or decrease the speed until you get a count of 80 r.p.m. Actual playing speed, allowing for the weight of the pickup on the record, will then be very close to 78 r.p.m., the speed for which most commercial recordings are cut.

LIST OF PARTS

C1: 10-mmf. air-spaced trimmer.
C2: 360-mmf. midget tuning condenser.
C3: 200-mmf. mica.
C4: .01-mfd., 600 volts.
C5: .02-mfd., 600 volts.
C6: 8-mfd., 150-volt electrolytic.
R1: 250,000-ohm volume control, with switch. See S2.
R2: 100,000-ohm, ½-watt carbon.
R3: 1-meg., ½-watt carbon.
R4: 600-ohm, 2-watt carbon.
S1: S.P.D.T. toggle switch, with long neck.
S2: D.P.S.T. switch on volume control.
X: 1N34 fixed crystal.
L1, L2: shielded antenna coil.
T: Midget output transformer.
Crystal pickup, spring-wound motor, batteries, 5″ P.M. speaker, cabinet, dial, knobs, etc.

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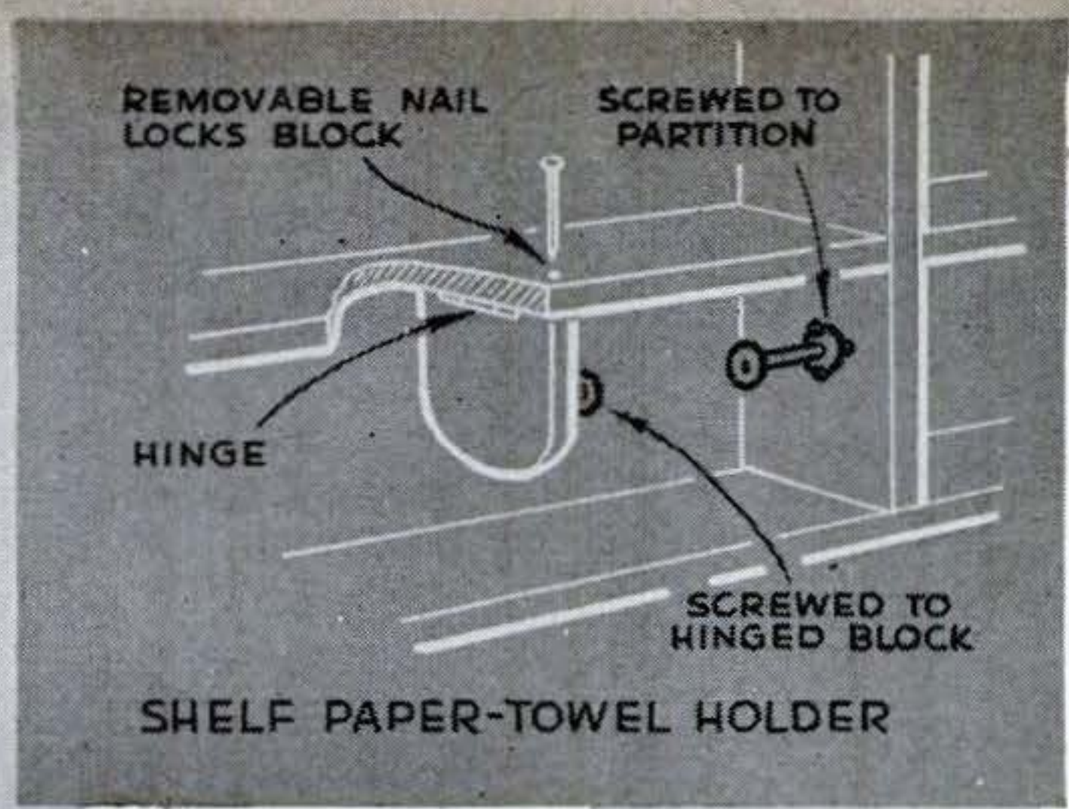
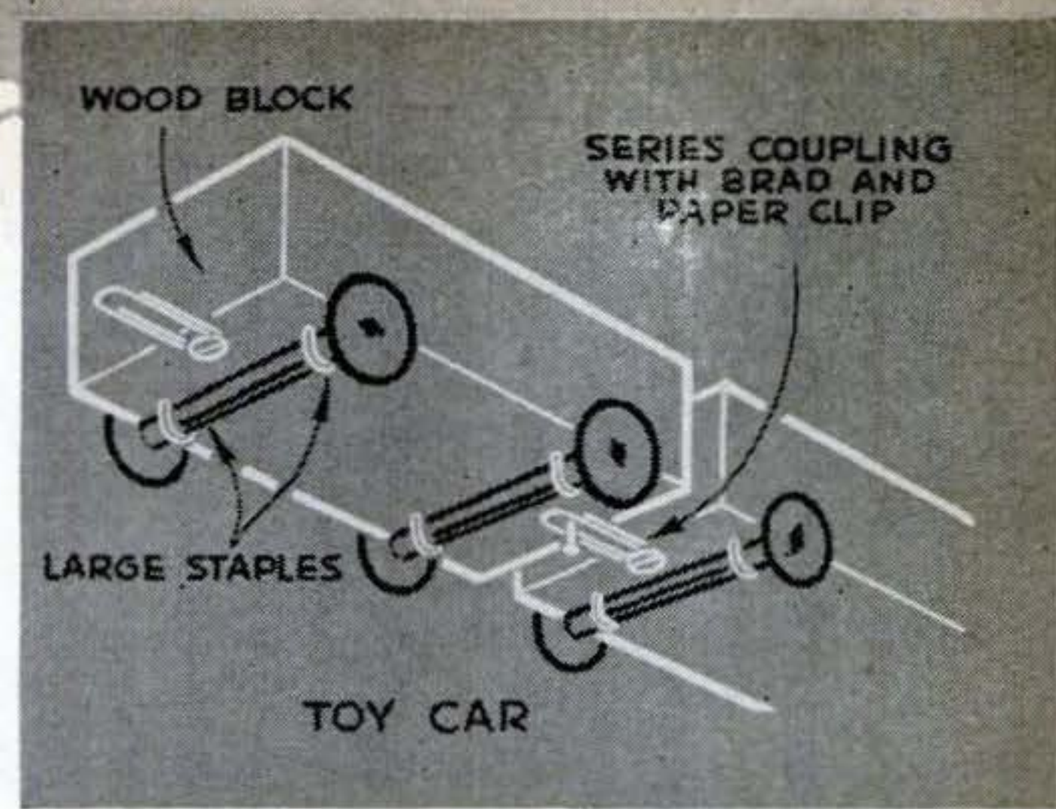
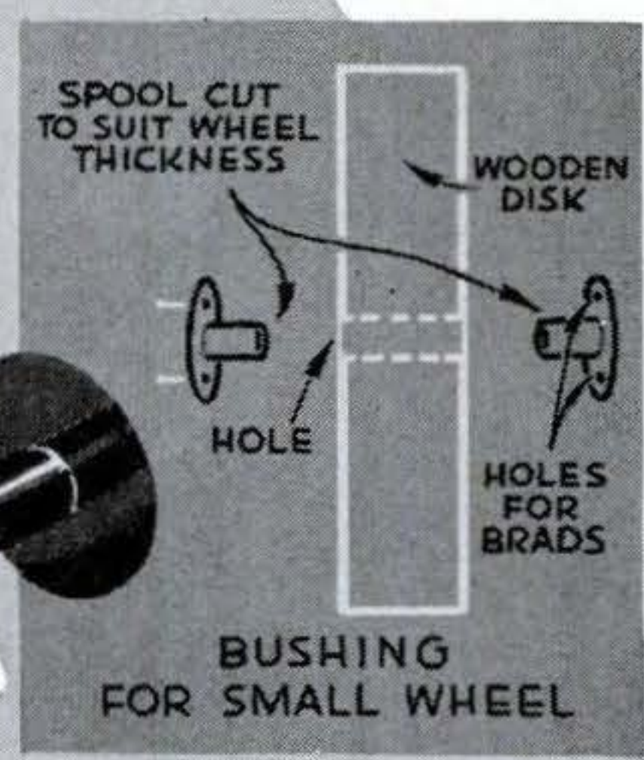
Nine Uses for Empty FILM SPOOLS



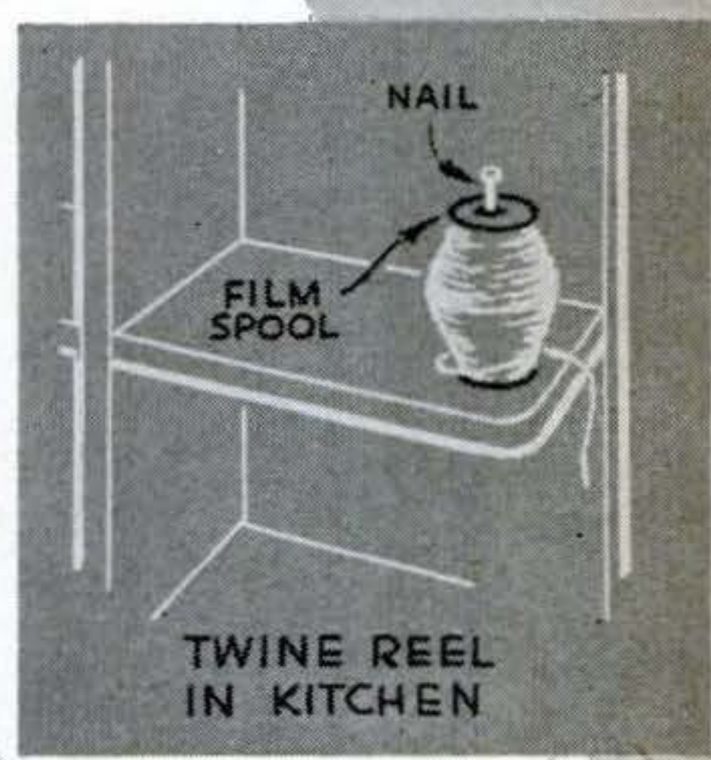
SHELF PAPER-TOWEL HOLDER



TOY CAR

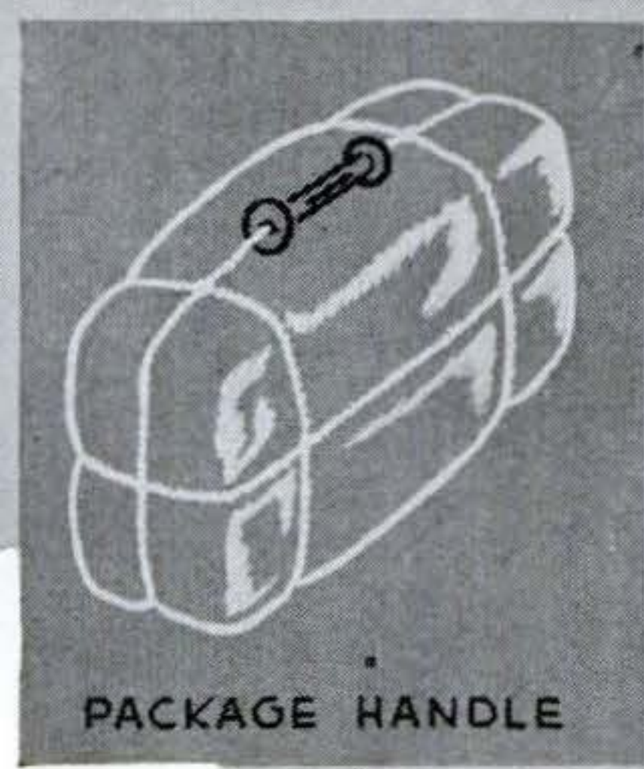


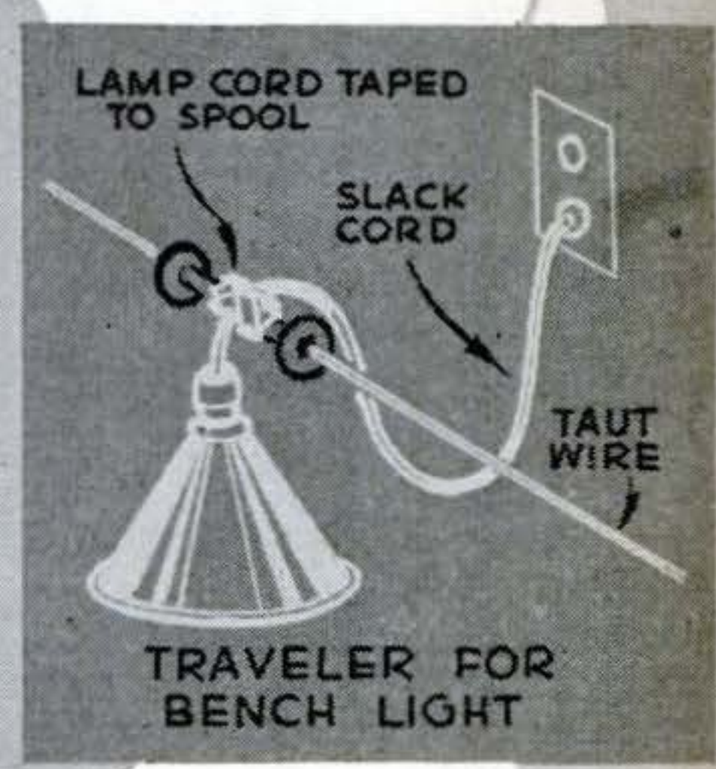
BUSHING FOR SMALL WHEEL



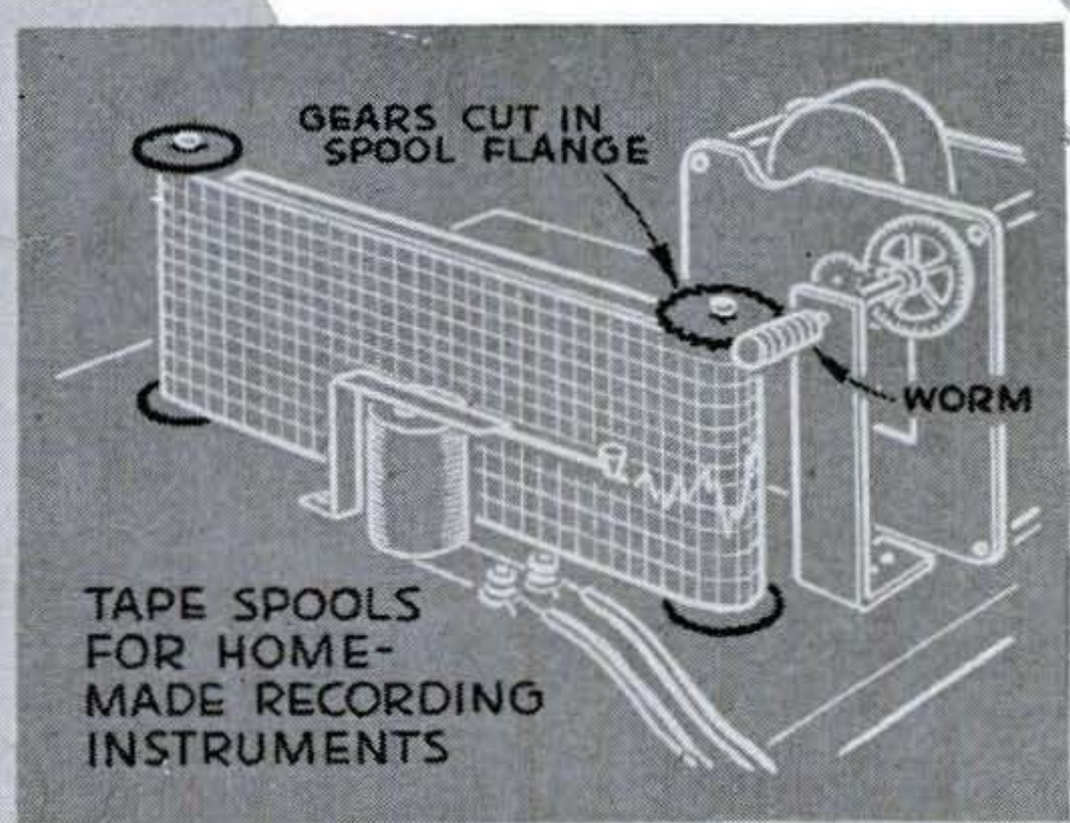
TWINE REEL IN KITCHEN

SPOOLING SCRAP WIRE

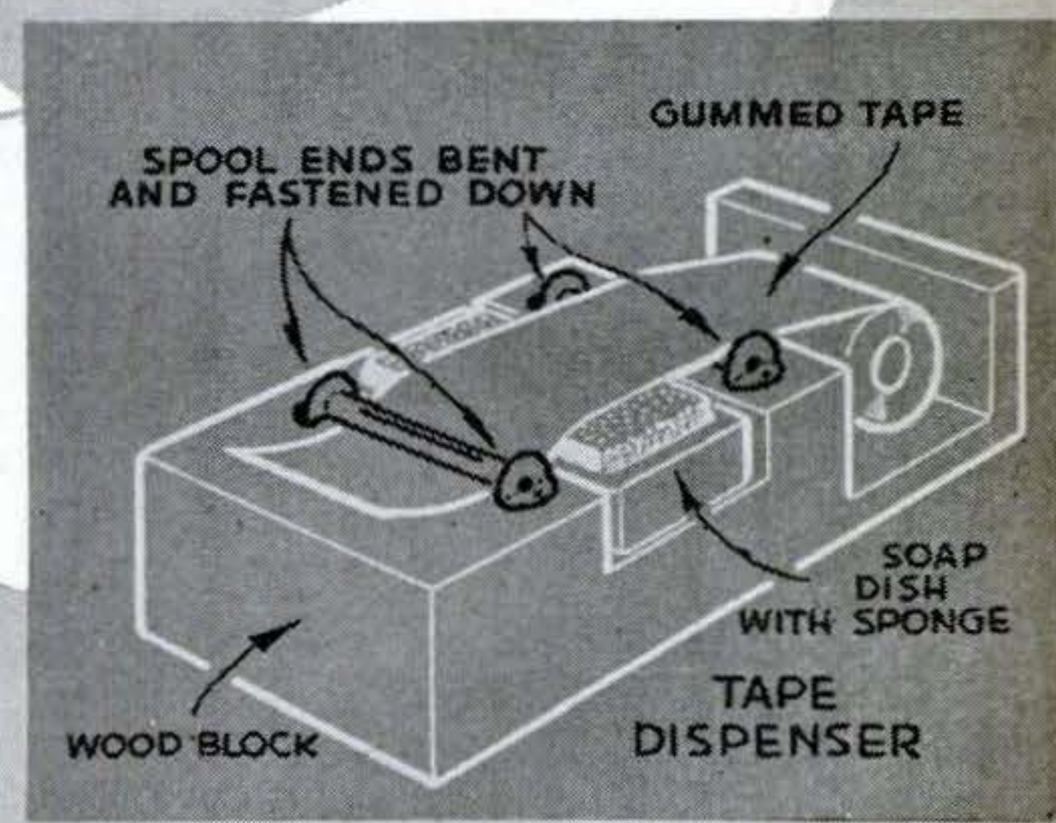

PACKAGE HANDLE



TRAVELER FOR BENCH LIGHT

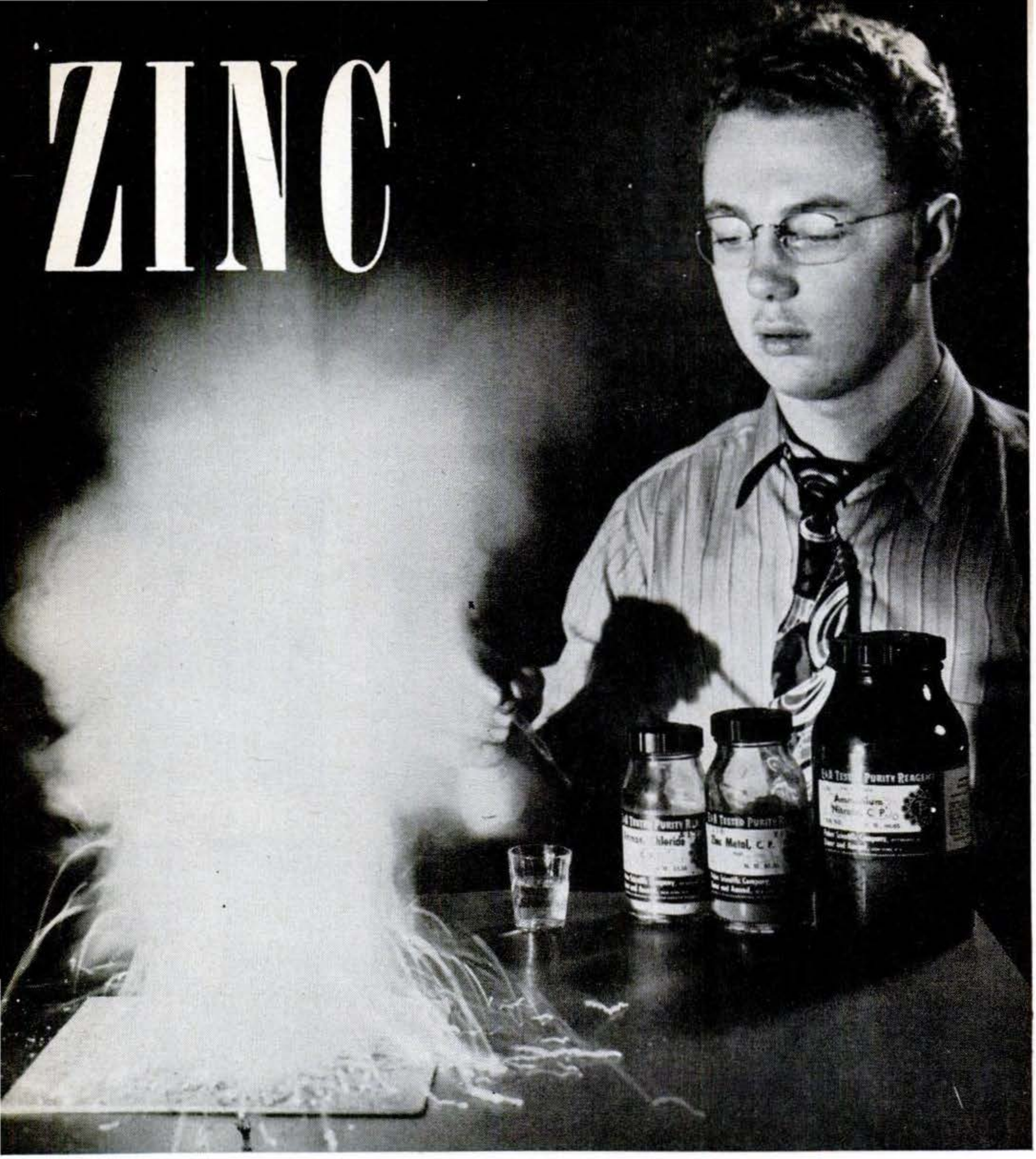


TAPE SPOOLS FOR HOME-MADE RECORDING INSTRUMENTS



TAPE DISPENSER

ZINC



Combine a few grains of zinc dust, ammonium nitrate, and ammonium chloride, add a single drop of water, and you get this volcano-like eruption. The chief component of the cloud of smoke is white zinc oxide.

From brazen helmet and warrior's shield of the ancient world to the modern flashlight cell and galvanized steel plate, zinc has worked in the service of man.

By

KENNETH M. SWEZEY

THOUGH it seldom makes headlines, humble zinc ranks with iron, copper, and lead as one of the most widely used metals in the world. Hundreds of thousands of tons of zinc are used annually as a molten dip to coat iron and steel pipes, tanks, and roofing for protection against corrosion. The process is known as galvanizing.

Brass is made of about 30 percent zinc and 70 percent copper. Granular zinc and zinc dust are used in the laboratory to release hydrogen from acids, to recover gold and silver from solutions, and in organic

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synthesis. More than 500,000,000 zinc cases for use in electrical dry cells are manufactured every year.

Made in great quantities by roasting zinc ores in a large excess of air, zinc oxide is important in forming other zinc salts, for ointments and dental cements, and as the paint pigment "zinc white." Although zinc white lacks the covering power of white lead, it is not poisonous and is not discolored by hydrogen sulphide. Zinc is the only common metal having a white sulphide. Compounded with barium sulphate, zinc sulphide forms a still better white pigment, lithopone.

Zinc chloride *(caustic: handle with care!)* is used as a soldering flux, in manufacturing dyestuffs, in sizing and weighting textiles, and as a wood preservative. In strong solution it can convert the cellulose of paper and wood into soluble compounds, and is thus used in the process of making "vulcanized fiber." Zinc stearate is commonly used as a baby powder.

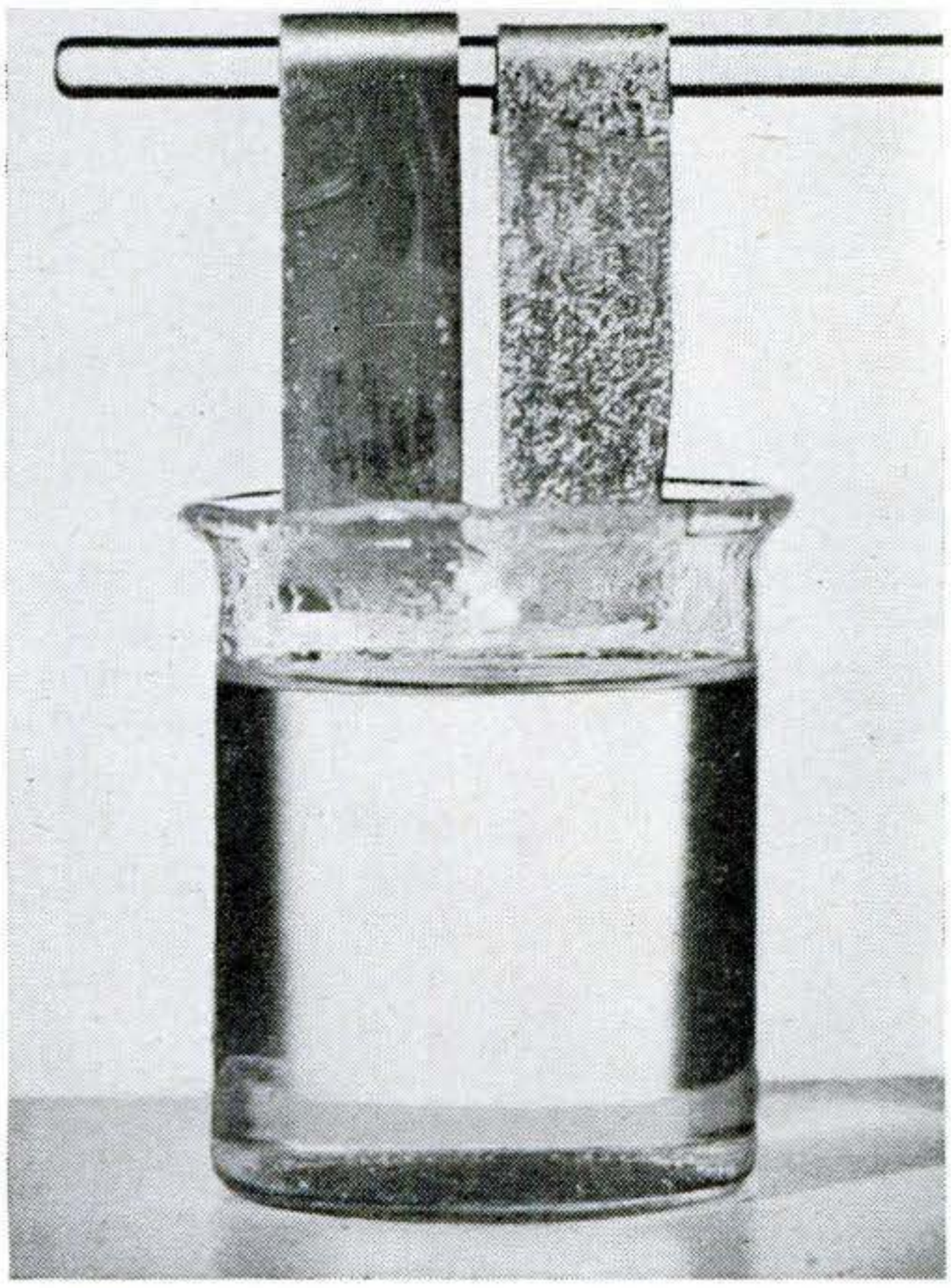
Because it is so active chemically, zinc never occurs free in nature. Its compounds, however, are widely distributed—often mixed with the ores of other metals. As a consequence, zinc was used unwittingly for centuries before it was recognized as a distinct metal. By smelting zinc-bearing copper ores, the Romans, for instance, used zinc to make brass without ever knowing it. Zinc has often been confused with lead, tin, and bismuth. As an element, it has been known for only 200 years.

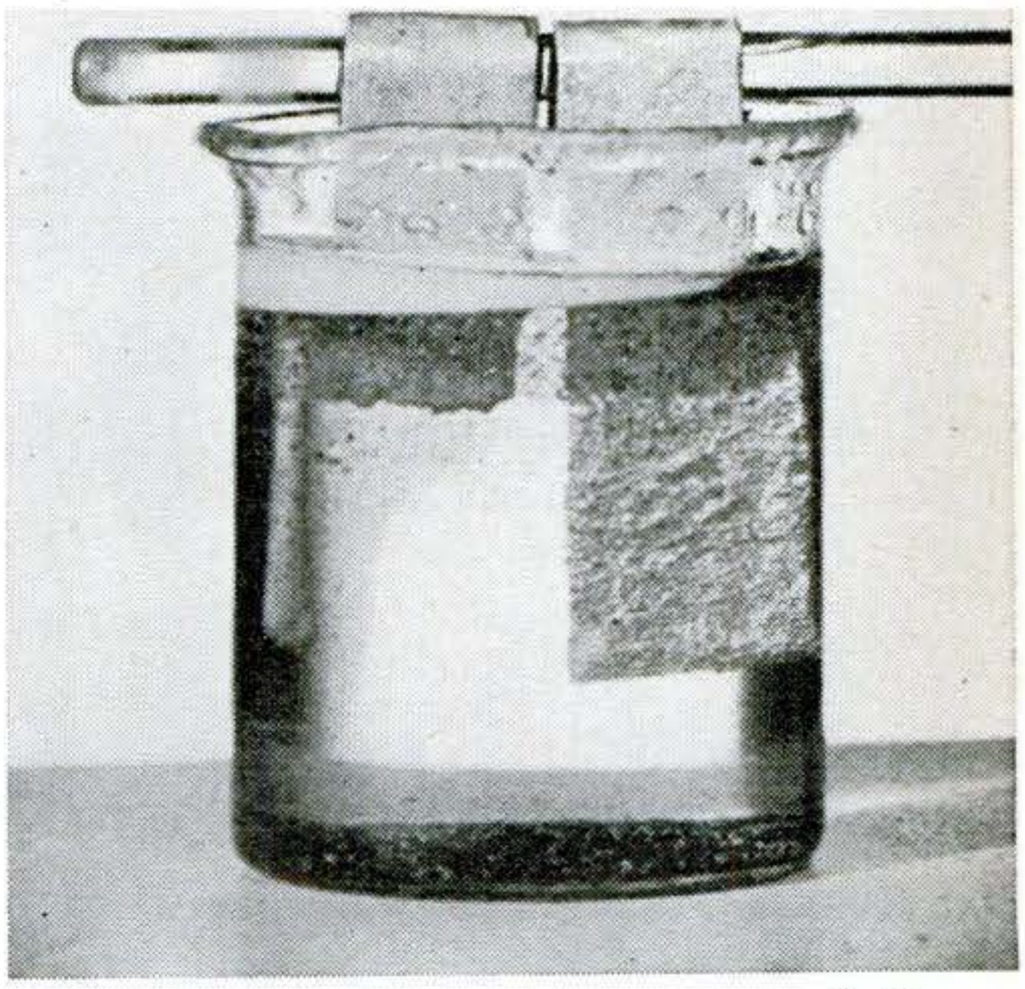
The chemical activity of zinc may be spectacularly demonstrated. On the center of an asbestos mat mix together about ¼ teaspoonful each of zinc dust and ammonium nitrate. Mix them gently, and be sure that both ingredients are dry; otherwise they may react prematurely. On top of the heap place a few grains of ammonium chloride, and stir in slightly. Then make a small depression in the top of the mound.

Everything set, put just one drop of water in the volcano-like crater and stand back. In a matter of seconds, the zinc ignites and flashes with a brilliant blue-white flame accompanied by a cloud of dense white smoke.

The single drop of water promotes a complex reaction that liberates ammonia, hydrochloric acid, water vapor, and nitrous oxide. Oxygen from the nitrous oxide unites with the zinc, forming white zinc oxide. This makes up the greater part of the cloud of smoke.

Although chemically pure zinc reacts very





Chemically pure zinc will react slowly with dilute acids, but if the metal has the slightest trace of impurity the action becomes so rapid a strip will be eaten away in a few minutes. A thin coating of mercury on the strip at right in the photos brings pure zinc to the surface as a protective layer.

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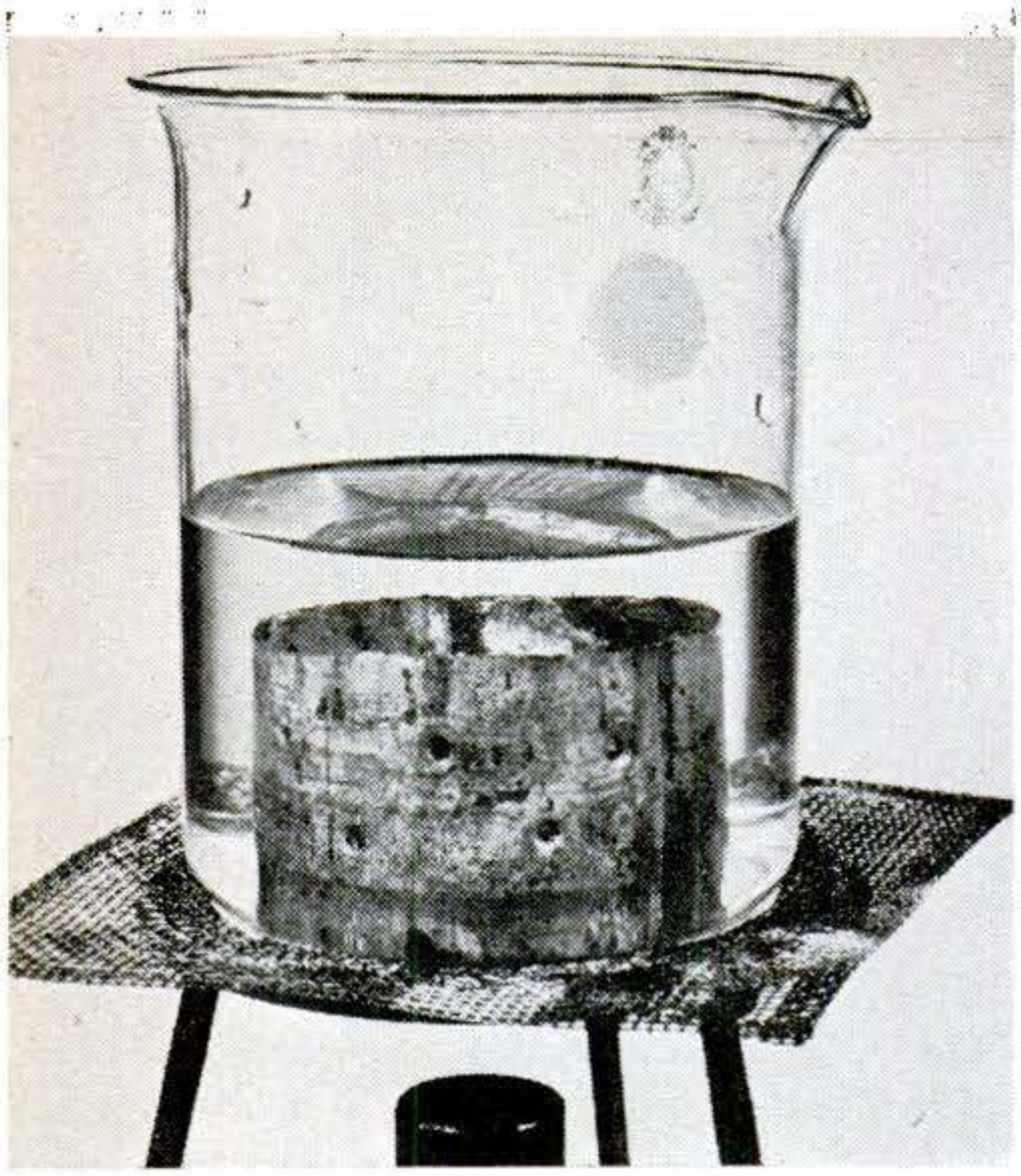

Electroplating without a battery is possible if a zinc cup containing the parts to be plated is put in the plating liquid. The cup acts as the anode.

In 10 or 15 minutes the plated parts can be taken from the plating fluid. Copper, zinc, and nickel may be plated on other metals by this method.

slowly with dilute acids, a slight trace of some less active metal or impurity, such as is found in ordinary commercial zinc, causes the reaction to become rapid. A thin coating of mercury applied to nonpure zinc, however, dissolves some of the zinc and produces a surface that behaves as if the zinc were pure. This application of mercury, called amalgamation, reduces the wasting away of zinc battery plates when a battery is idle.

You can demonstrate this difference in activity by amalgamating a strip of commercial zinc and suspending it beside an untreated strip in a beaker of dilute sulphuric acid. To amalgamate the zinc, first remove the surface film by rubbing with fine sandpaper or steel wool. Then, using a small wad of cotton, rub a drop of mercury over the faces and edges until they are uniformly coated.

Now suspend both strips of zinc in the acid (one part sulphuric acid added carefully to five parts water will do). Bubbles of hydrogen in great volume arise immediately from the untreated strip, while the amalgamated piece releases almost no hydrogen at all. The untreated zinc is indeed acted upon so rapidly that it disappears completely in a matter of minutes.

Zinc will replace most common metals merely by being put in a solution of them. Here is a "lead tree" formed by a zinc strip placed in lead acetate.

Because zinc is more electropositive than iron, copper, or brass, small pieces of these metals can be electroplated with other metals merely by placing them in contact with a zinc cup submerged in a hot plating bath. In this batteryless plating method the zinc acts as an anode while the objects to be plated serve as the cathode. A weak current is set up between the two and causes metallic ions from the bath to be deposited on the cathode.

To obtain a cup for the experiment, saw off the bottom third of an exhausted standard dry cell, empty the contents, and puncture a number of holes in the sides and bottom to permit circulation of the plating liquid. Place the cup in an unchipped enameled pan or a large beaker over a source of heat.

For a liquid with which you can plate copper on iron or steel, dissolve 15 grams of potassium bitartrate (cream

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of tartar), 6 grams of sodium hydroxide, and 4½ grams of copper sulphate in 250 ml. of hot water. After thoroughly cleaning the objects to be plated, put them in the cup and submerge it in the plating fluid, which is kept hot to reduce resistance. The cup may be removed and drained in 10 or 15 minutes and the objects rinsed and dried.

Zinc may be plated on iron and steel by the same method, but using a bath of 17 grams of zinc chloride and 5 grams of ammonium chloride in 250 ml. of water. To plate nickel on copper or brass, use 10 grams of nickel ammonium sulphate in 250 ml. of water.

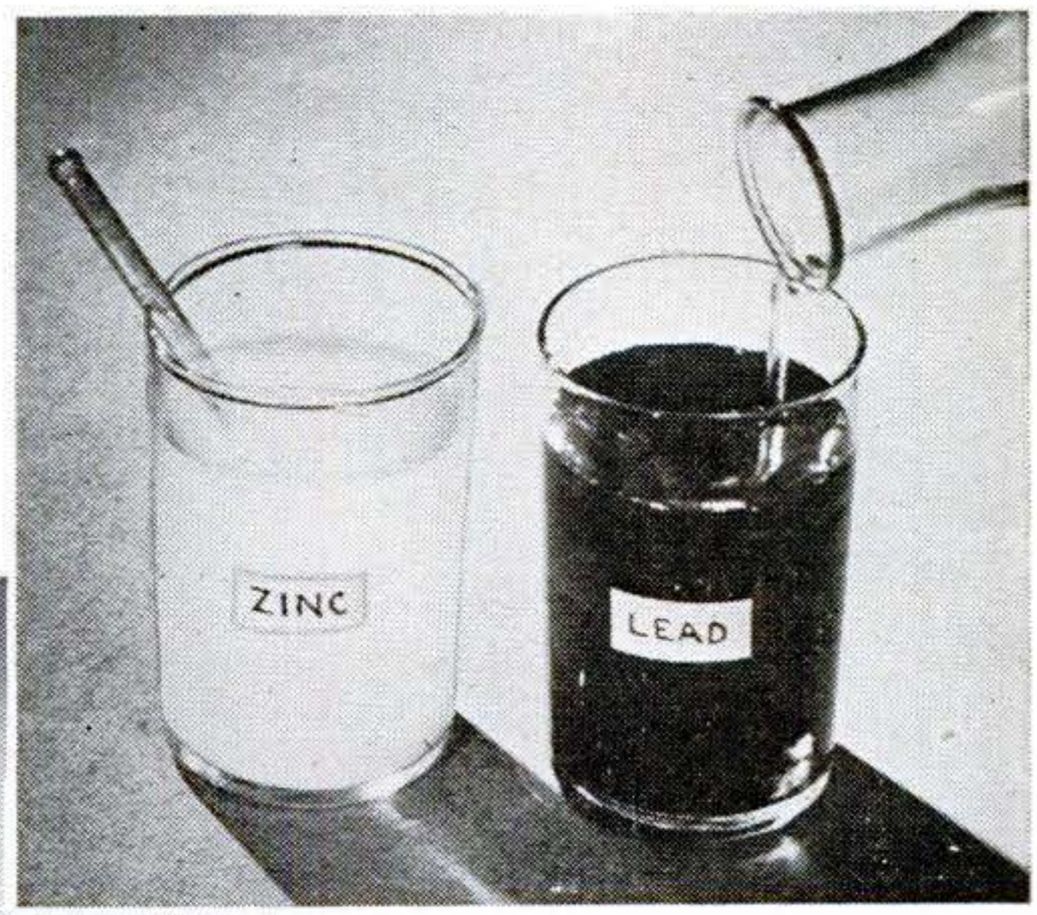
Because it stands near the top of the electromotive series of elements, zinc will replace most common metals when it is put into a solution of one of them. Practical use is made of this property when zinc dust or shavings are used to recover gold and silver from the cyanide baths employed in metallurgy and silver from exhausted photographic hypo.

A fascinating demonstration can be performed by immersing a strip of zinc in a solution of lead acetate. Fasten the strip to the cover of a half-pint jar, and then polish the strip with sandpaper or steel wool to remove surface film. Fill the jar with a solution of 30 grams of lead acetate in hot water, and screw on the top.

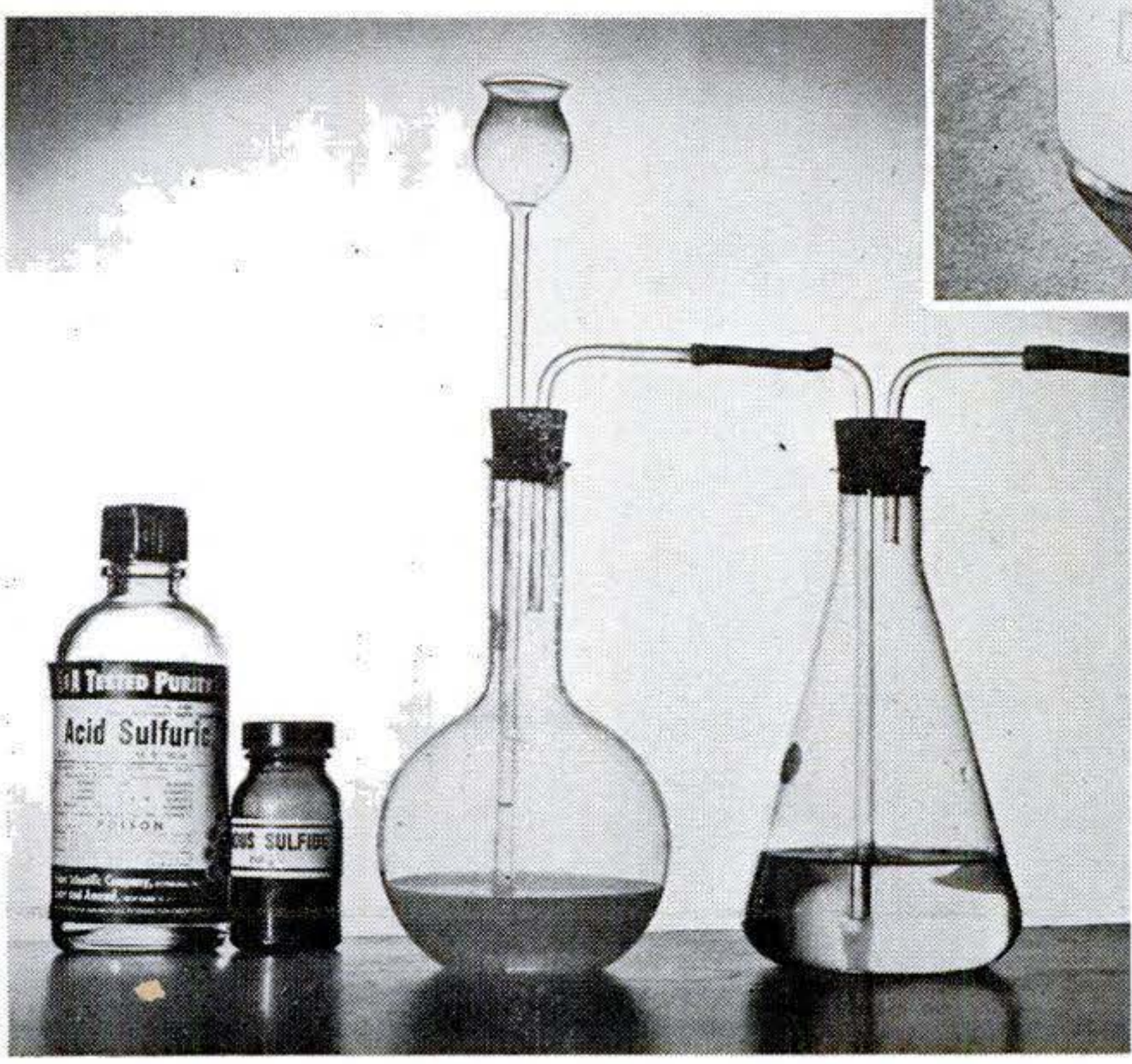
If it is left standing overnight, next morning you will find in the jar a beautiful "lead tree" composed of a voluminous cluster of crystals of metallic lead. Part of the zinc dissolves, replacing the lead in the lead acetate and forming zinc acetate.

Since the sulphide of zinc is the only sulphide of a common metal that is white (the others range from yellow to black), paint mixed with zinc salts remains white longer in atmosphere containing hydrogen sulphide than does paint mixed with white lead (basic lead carbonate). You can show this by pouring a little hydrogen sulphide water into clear solutions of zinc chloride and of lead acetate in water. Their salts transformed into sulphides, the zinc solution turns milky white, the lead inky black.

A solution of hydrogen sulphide for the experiment can be made by bubbling some of this gas through water in an apparatus set up as in the photo at left below. The generator is a flask containing several grams of ferrous sulphide covered with water. The reaction is started when a little concentrated sulphuric acid is poured in. END



Why zinc in paint pigments doesn't discolor in air that darkens lead is shown when hydrogen sulphide is added to clear zinc chloride and lead acetate solutions. The zinc turns white, the lead black.



Hydrogen sulphide water for use in the test is made with an apparatus like that shown at left. Ferrous sulphide is put in the generator flask, and sulphuric acid is added through the thistle tube. The gas bubbles through water in the next flask. Excess poisonous gas is led outdoors through the tube at right.

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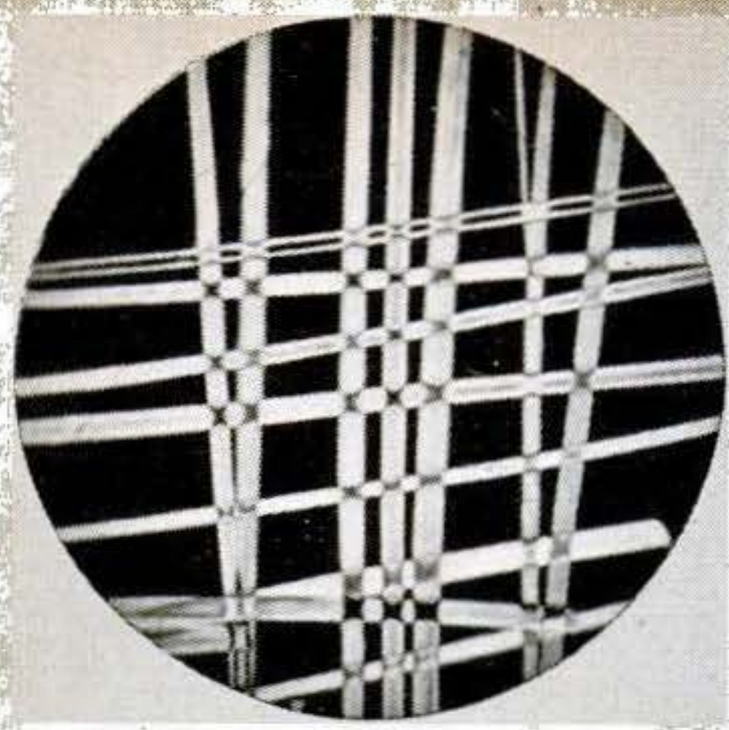
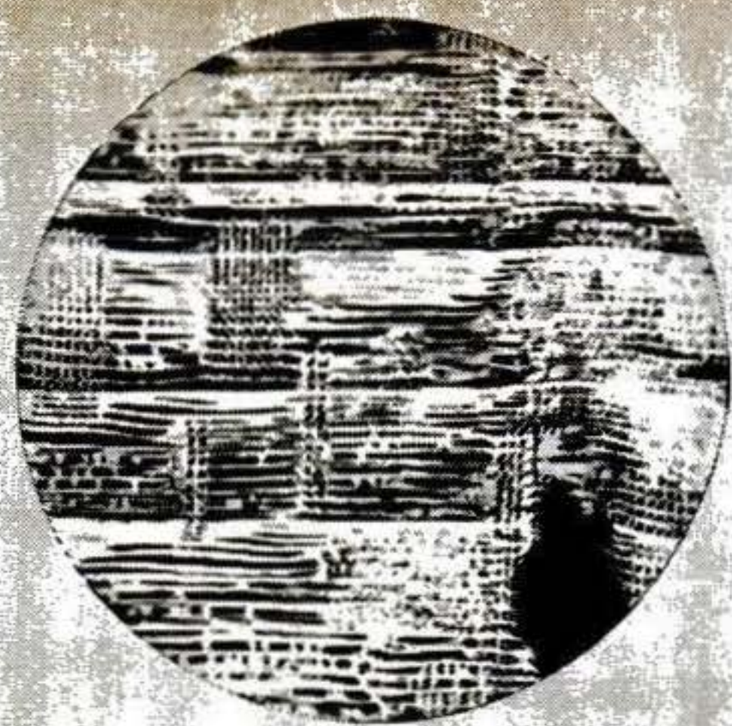


HUMAN HAIR



SECTION OF PINE WOOD

SUGAR CRYSTALS

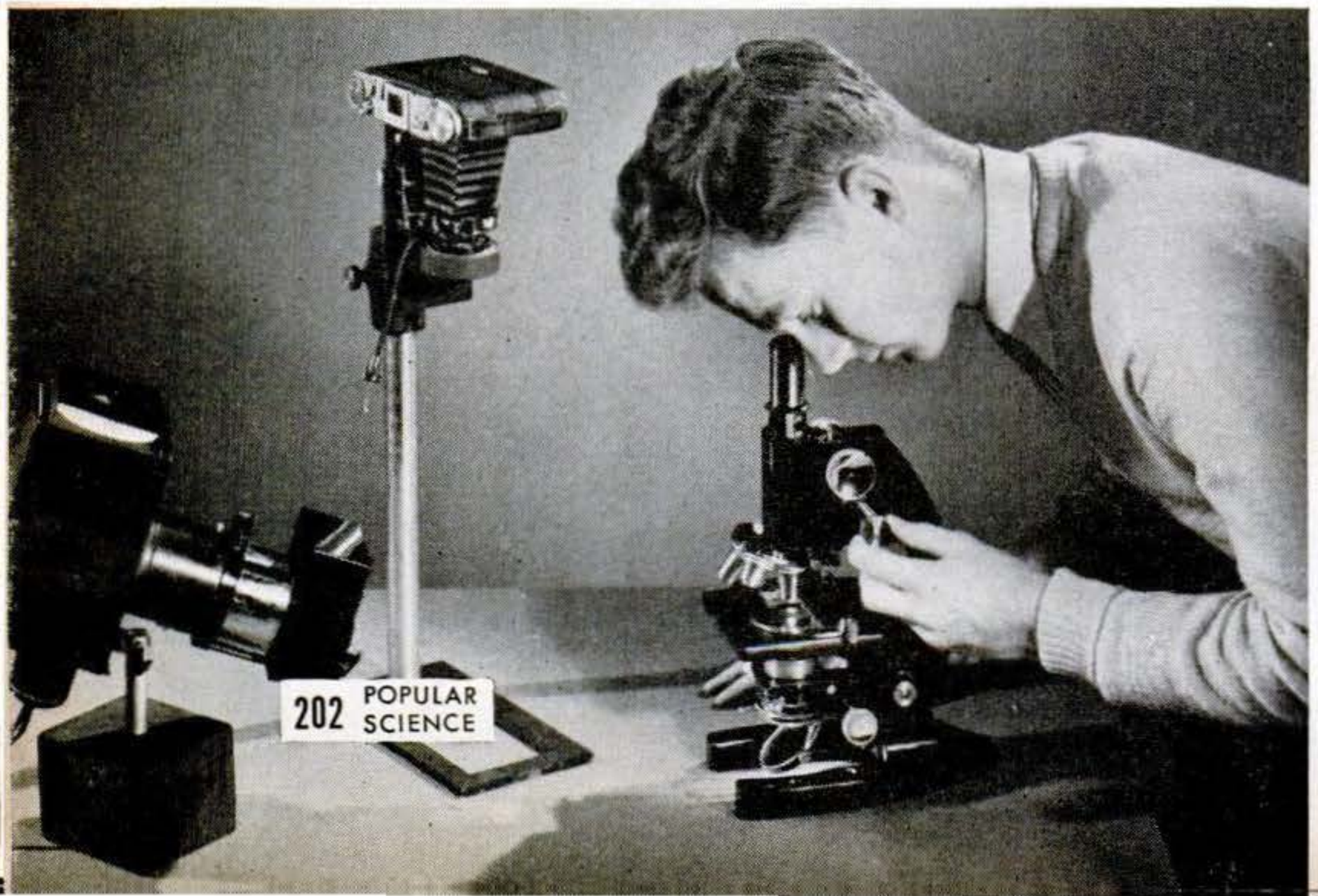
SPIDER FANG

Hitch Your Camera to a MICROSCOPE

PHOTOGRAPHS of the strange and fascinating world under a microscope can be made with practically any camera. Even a box camera will do if you are careful.

Illustrated below are the steps that should be followed to produce photomicrographs of the type shown on this and the facing page. If you are unable to find a stand to support your camera vertically, both the camera and microscope can be placed in a

1 Here is the equipment you will need—a microscope, an illuminator, and a stand to hold the camera vertically. (If such a stand is unavailable, you can place the camera and microscope in a horizontal position as seen on the next page.) After setting up the microscope and its illuminator, insert the slide that is to be photographed and adjust the microscope until the image is brought into sharp focus.



2 Then move tissue paper up and down above the eyepiece until you find where the rays converge to form a spot of light, called a Ramsden disk. This is a guide for positioning the lens.

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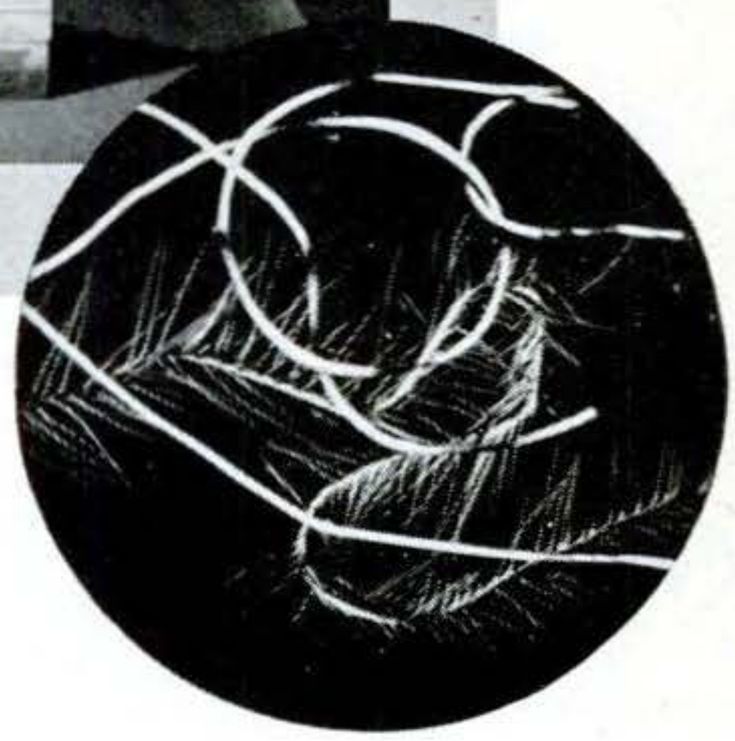
horizontal position, as above. Exposures will be determined by such things as lighting, magnification, and subject matter. It will be wisest at first to take several shots of each subject at different shutter speeds.

Photos by Eastman Kodak



WOOL THREADS AND OSTRICH FEATHERS

3 After setting the camera at infinity and centering the lens at exactly the level of the Ramsden disk, check the camera focus with the ground glass or a sheet of tracing paper held over the open back. Centering the camera correctly may take a little practice.

4 When the camera has been locked in position, seal out exterior light by connecting the camera and the microscope with a light lock or by draping both with a black cloth. With fast panchromatic film in the camera and the lens opened to its largest aperture, exposures probably will range somewhere between 1/25 and 1 sec.

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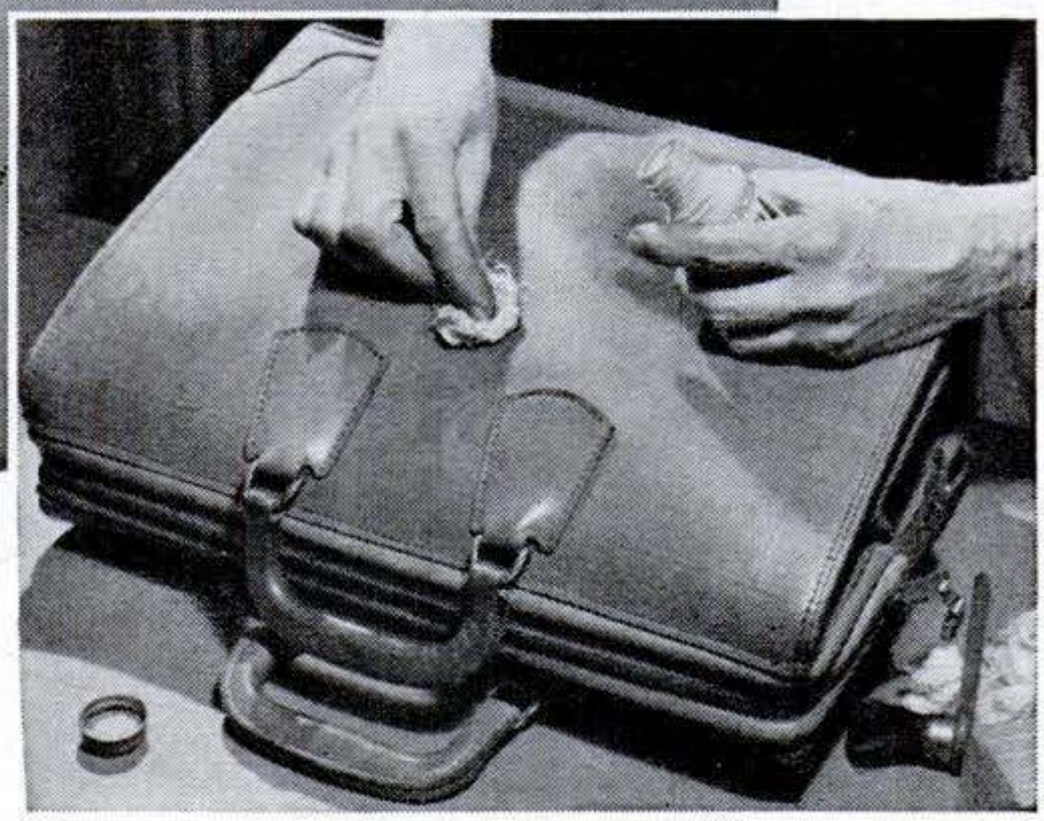
More Mileage from Your LUGGAGE

By WALTER E. BURTON



Dressing with shoe polish once every year or so will preserve leather luggage by keeping the oil from drying out. Here a neutral cream is used.

GIVEN reasonable care, good luggage will last a lifetime, but often a stitch in time is necessary to obtain the most from it in useful service. Many a supposedly worn-out piece can be restored to duty at the cost of a little effort. There are many shops specializing in luggage repair; but the average person, with a little time and patience, can do most jobs himself.

Any traveling bag or other leather piece that has been neglected will, first of all, need a thorough cleaning. Sponge the leather with saddle soap or a mild laundry soap and water, and rinse to remove the soap, taking care not to soak the material. Then set the bag aside to dry naturally. Do not place it near a radiator or other heat, as heat will make wet leather stiff and brittle. Dirt that sponging fails to remove may yield to carbon tetrachloride or other dry-cleaning solvent, and in an extreme case a little lacquer thinner may be used.

If there are no repairs to be made first, faded color may be restored next by use of a regular leather or shoe dye or a combination dye and polish. After this it is advisable, particularly because of the strong odor, to allow a drying period of several days. Then the leather should be lubricated, if the original fats have dried out badly, with a swabbing of a hot half-and-half mixture of neat's-foot oil and lanolin. A good shoe polish, buffed to work up a luster, will serve in ordinary cases, and it is a good idea to give leather luggage such a treatment at least once a year, probably at the end of the annual vacation trip.

Artificial leathers and synthetic coverings can usually be cleaned with a damp cloth or soap and water. Cleaning fluid may be required on a stubborn spot, or lacquer thinner or waxless paint remover if used with caution. A test on a spot that doesn't show will indicate whether the solvent will damage the finish. Sometimes a coat or

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two of shellac will brighten the surface.

"Airplane cloth" is safely cleaned with soap and water. Stubborn dirt can be removed with lacquer thinner if the cloth is the kind made with a lacquer-type filler. It must then be refinished with clear linoleum lacquer. Some new finishes react to lacquer, varnish, and pyroxylin cements unfavorably, so it's safest to apply such to a small area for a 48-hour test first.

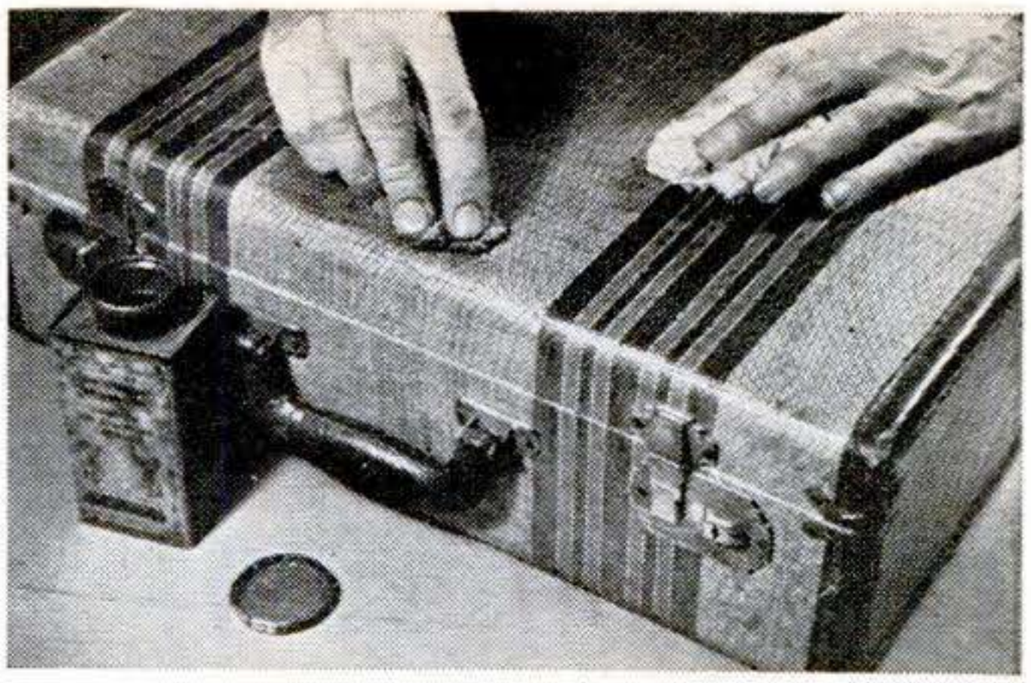
Go over the piece after cleaning to look for snags, rips, scuffed spots, open seams, and the like. Some repairs may be made simply by gluing down loose ends of snags; others may require stitching, riveting, or replacement of a part. Quick-drying household cement and model-airplane glue will adhere to both leather and nonleather surfaces. On plastic finishes, test it first.

Holes and badly torn places require patching. Clean the edge of the damaged spot with a sharp knife, beveling it downward, and cut a piece of leather or other matching material to fit, also beveling its edge. Apply cement thinly to both the patch and damaged spot, let dry, apply more cement, and press the patch on, smoothing it with a knife blade. Weight the patch down until the cement sets. In some cases it may be necessary to reinforce the patch by sewing.

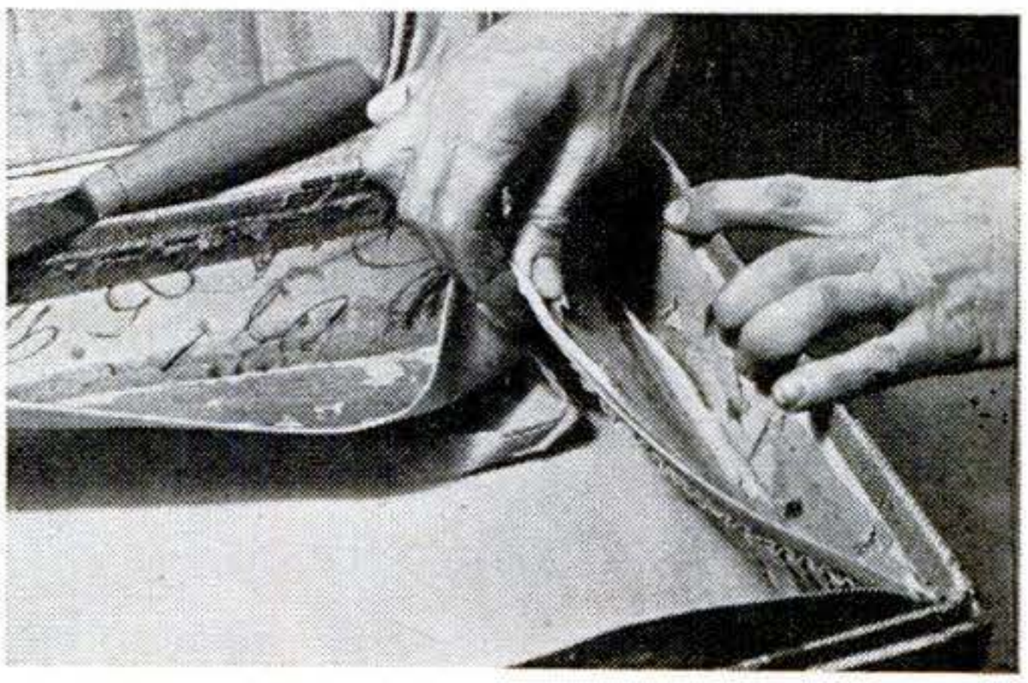
Metal and other fittings frequently pull loose when a bag has had rough treatment, and new pieces of leather are needed for reattaching them. When these are held by rivets, try to get rivets like the original ones. Split rivets of the kind once widely used for attaching automobile brake linings to brake shoes will serve. Brass rivets are rustproof, but they are not as strong as steel. Split rivets may be spread by placing the side of a pin punch on the points and striking with a hammer. A center punch will work for tubular rivets if a regular riveting tool is not available. Sometimes it is advisable to place a burr or rivet washer over the rivet before clinching, as in Fig. 1 on page 207. Solid rivets may also be used but only with burrs.

In removing old rivets be careful not to tear the leather or fiber. The two prongs of split rivets can be straightened with a screwdriver and pliers. Tubular rivets split into several prongs when installed, and each should be straightened before removal. The prongs of some tubular rivets fit into caps, which can be used again for new rivets.

Straps usually wear first at the buckle and can be repaired there with metal buckle-repair clips. The harness maker or luggage



Lacquer thinner removes spots on "airplane cloth" that resist soap and other cleansers. A bag so cleaned, however, must be relacquered.



When a cloth lining becomes badly soiled, it can be removed and washed. In an overnight case, the lining is usually glued to the rigid frame.

Leather trim on a cloth bag is replaced by putting stitching through the original holes in the wood frame. Remove the lining to expose them.

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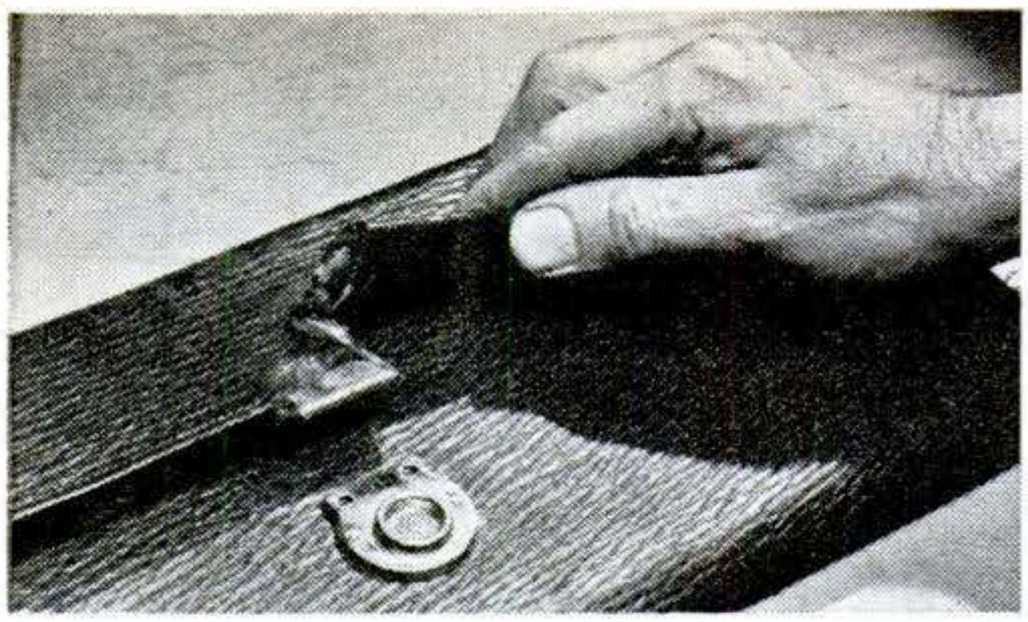
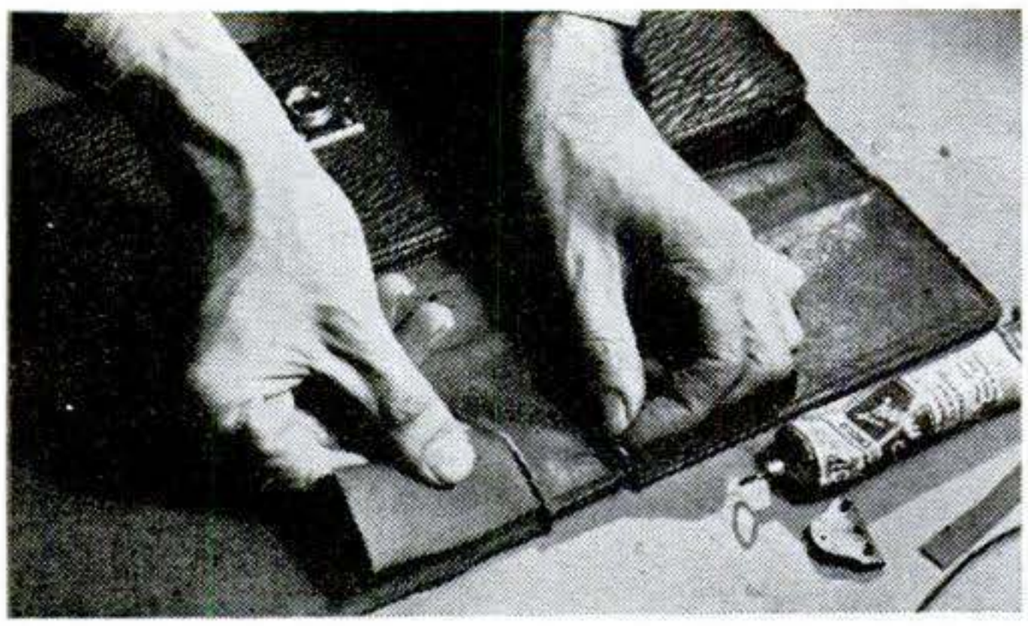
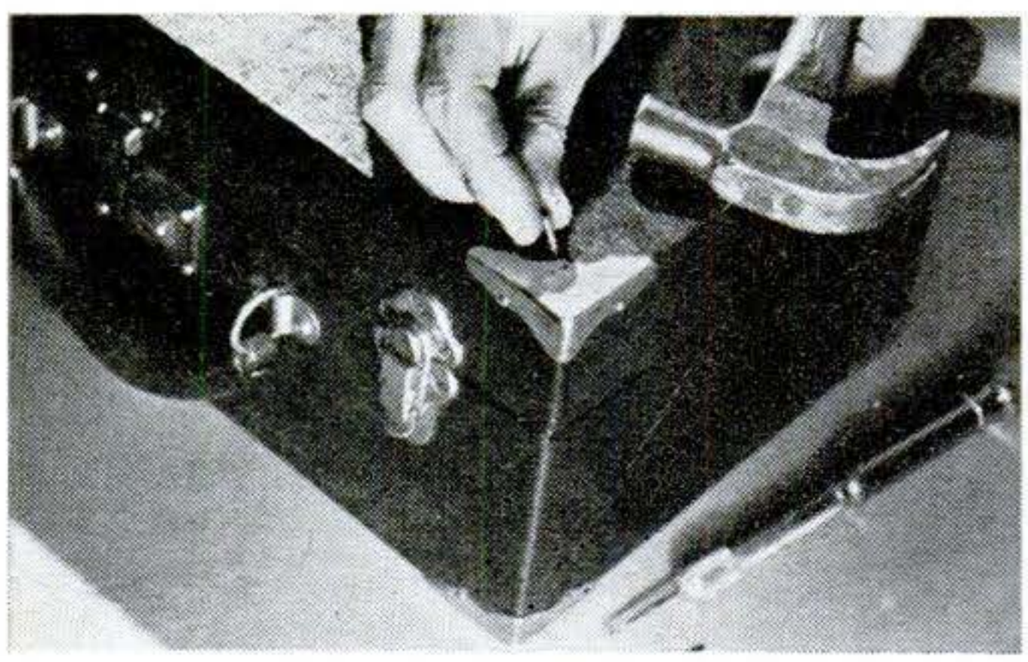


Briefcases in almost daily use sometimes tear at the catch. This one was repaired by removing the catch, splitting the lining evenly, and then . . .



. . . making an insertion of a reinforcing strip of fabric or leather. The break was cemented, and the leather dressed with shoe dye and polish.



Metal or leather crash corners put on with nails, rivets, or cement will add ruggedness to luggage.

The prongs of a split rivet holding leather parts are spread with a pin punch and hammer. A center punch does the job on tubular rivets.

shop that supplies them can also cut a new strap to order.

Stitching is often the first thing to fail, for the threads rot in time and break with scuffing or under strain. It is a good idea to look for weakness when other repairs are being made and to restitch if necessary. A handy gadget is a lock-stitch sewing awl of the type used by harness makers, but a satisfactory, if slower, job can be done with an ordinary large needle. Load the eye with linen thread, carpet thread, or one of the various aircraft threads available at some war-surplus stores. If beeswax is rubbed on, the thread can be pulled through holes more easily and resists rotting longer.

The harness awl makes an automatic interlocking stitch. With an ordinary needle, run the thread down through one hole and up the next to the end, and then reverse the process, as in Fig. 2, and work back to the start. Punch holes in new work with a carpenter's awl before trying to push the needle through. Take the lining out of cloth-covered cases when leather trim is to be replaced—and wash the lining before putting it back. Usually the stitching goes through the plywood or fiber backing as well as the cloth, and the new thread should be run through the original holes.

Latches, locks, buckles, rings, hinges, and crash corners are among the hardware items commonly used on luggage. In most cases they merely become loose. If one should break, it may be possible to match it from the collection in your junk box. That failing, if it is one of a pair, two similar items may be taken from a less desirable piece of luggage and put on the piece being repaired, while a slightly mismated pair can take their place on the less-used bag. Breaks sometimes can be hard-soldered or welded.

New crash corners may be cut from sheet metal or leather, folded into pyramids as in Fig. 3, and soldered, cemented, or sewed. They are then riveted or sewed to the corners of the luggage to protect them against damage and wear. Dome-shaped furniture casters may replace the metal feet sometimes used.

Brass and similar hardware looks best after polishing, and a coat of clear lacquer helps retain the gloss. When the rustproof finish has worn off steel fittings, clean off rust and grease with an abrasive and solvent; then coat with colored lacquer or other finish and renew occasionally if the coating chips. A commercial chemical is available

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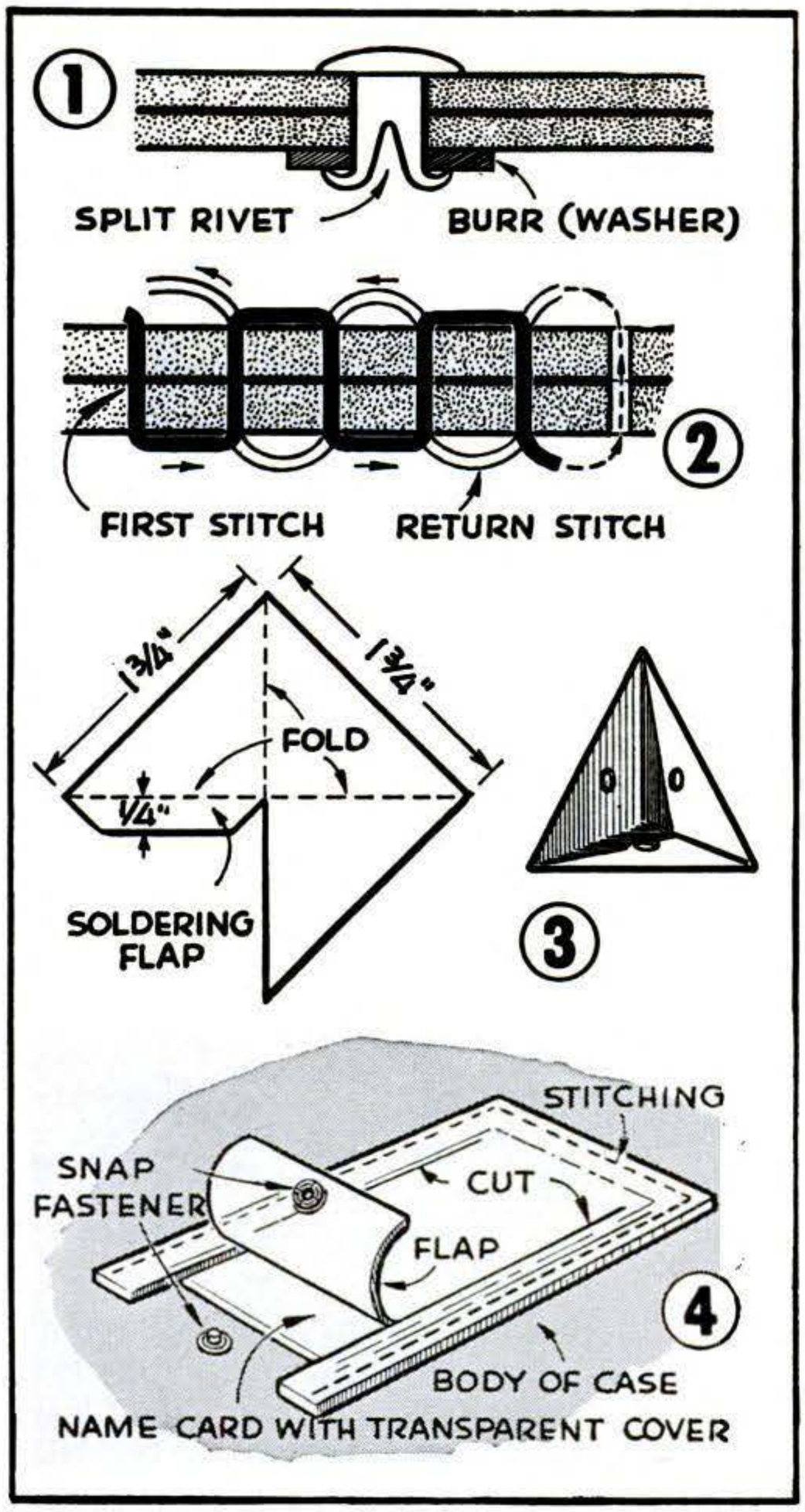

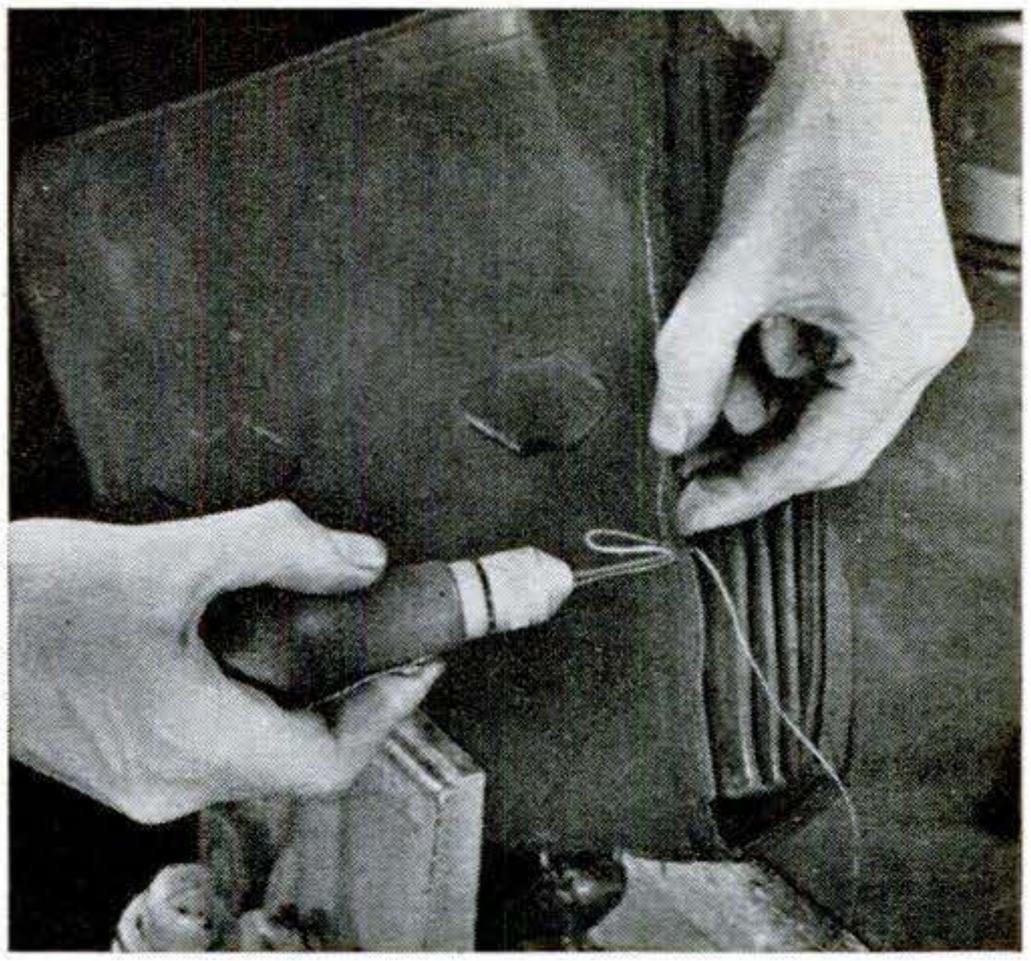

Stitching is speeded with a lock-stitch awl, but an ordinary large needle will do a good job. Put the thread through the original holes.

at gun shops for a rustproof blued finish, or the same result can be obtained by heating the metal part (detached, of course, from the case) in a gas flame until a uniform blue oxide forms. Apply a little linseed or lubricating oil after heating for rich color.

If you wish to identify your luggage with your name and address, you may want a homemade tag like that in Fig. 4. It has a leather flap that keeps your name from the casual reader. Figure 4 also shows a method of stitching the tag to the bag instead of hanging it on a strap. **END**

HEARTWOOD AND SAPWOOD [*WOODWORKING*]

Three distinct zones of wood show on the end of any log. Placed like a sheath around the outside is the bark; adjoining it is a light-colored zone called sapwood; and on the inside is the heartwood, usually darker in color. In addition, in the very center of the log, and usually of the heartwood, is the pith, which sometimes in the lumber trade is termed the "heart center." If a piece of lumber contains the pith, it is designated as "boxed pith"; if it does not, it is "side-cut" (pithless).

Trees grow by forming new layers of wood at the point where the sapwood and bark meet, the technical name of which is the "cambium." A young tree is entirely sapwood. As it grows older, the cells making up the central portion mature, become inactive, and usually turn darker in color, forming the heartwood. The thickness of the sapwood depends on the kind of tree, its age, and sometimes the growing conditions.

All heartwood was once sapwood, and the change that takes place has no effect on the mechanical properties of the wood, according to the National Lumber Manufacturers Association. Hence, there is no difference between sapwood and heartwood so far as strength is concerned.

Heartwood is more durable in contact with the soil and under conditions conducive to decay. It is, therefore, preferred if the material is to be used untreated under such conditions. Sapwood absorbs preservative better than heartwood and is preferred for treating purposes.

POPULAR SCIENCE MONTHLY SHOP DATA

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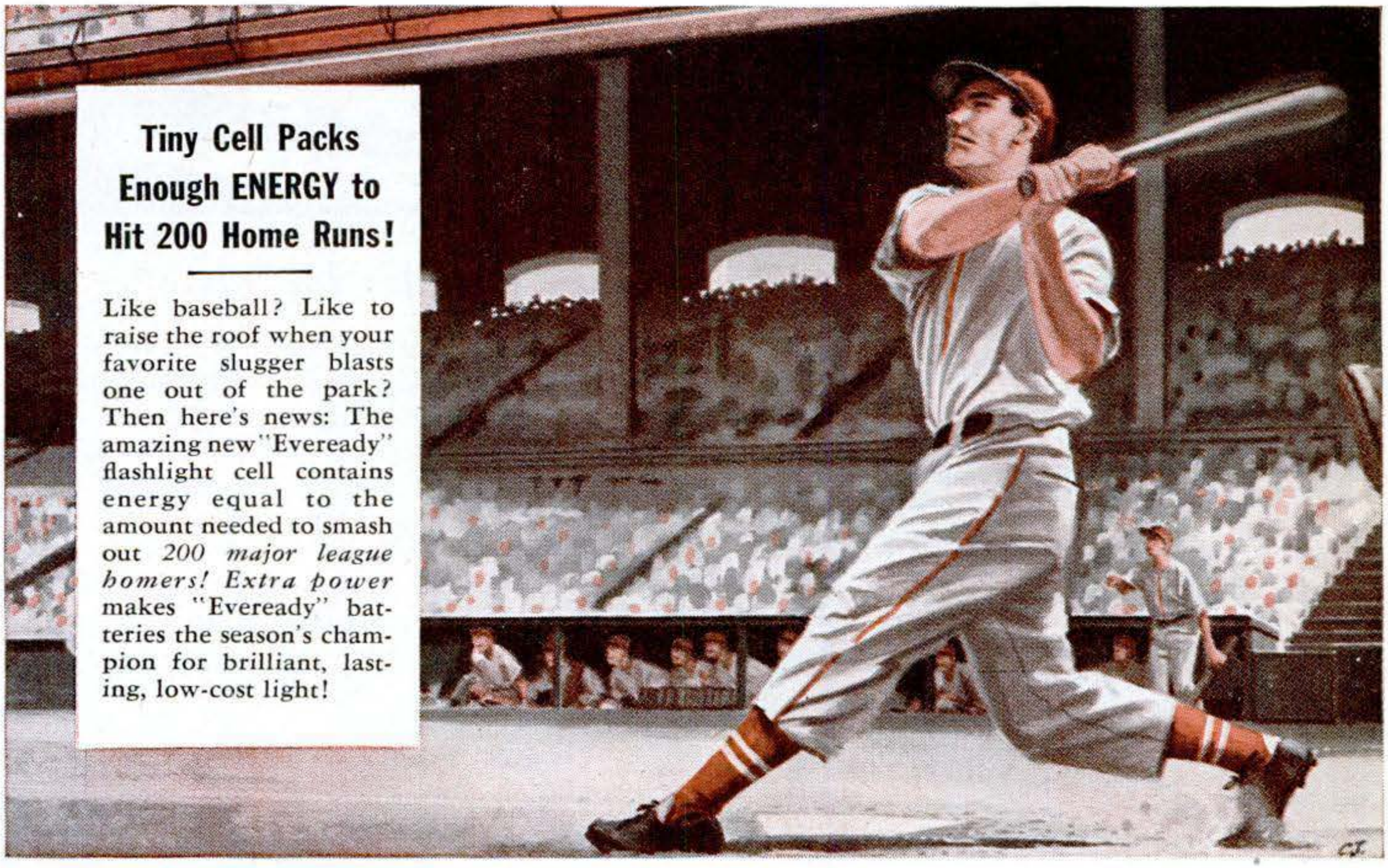
FOR EASIER FARMING

COMPRESSED-AIR PRUNER. A pruning tool operated by compressed air has been developed by Miller-Robinson Company, of Los Angeles. Named the Limb-Lopper, the tool will cut through green limbs up to 1¼″ in diameter, the jaws either opening or closing at the touch of a trigger. A heavy model has 12″, 18″, 36″, and 54″ extensions for work on the higher branches, while a lighter model has 3″, 12″, and 54″ extensions for work under the tree or on vines. A small portable air compressor and a length of hose are required. The tool makes up to 120 strokes a minute.

ELECTRIC CHURN. A special, slow-driven 1/20-hp. motor now being used in electric churns produced by the Alabama Manufacturing Company, of Birmingham, Ala., is said to have greater serviceability than the motor in the firm's pre-war models. The churn, which makes butter in 15 minutes, can be used with any standard crock or jar.

TIRE IS SELF CLEANING. A new tractor tire introduced by the Firestone Tire and Rubber Company is designed to shed mud and litter automatically from between the treads as it rolls. Because of this self-cleaning feature, the pulling power of the tire is said to be increased in loose earth. Curved traction bars that are braced at three points give the tire a center bite.

NEW "EVEREADY" FLASHLIGHT BATTERY LASTS 93% LONGER!



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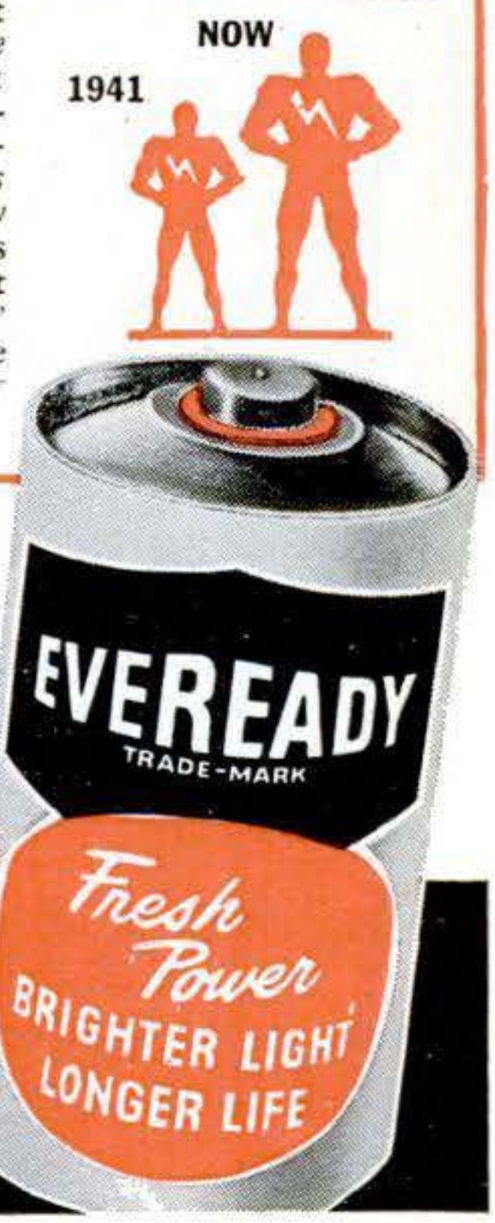

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FLASHLIGHT BATTERIES

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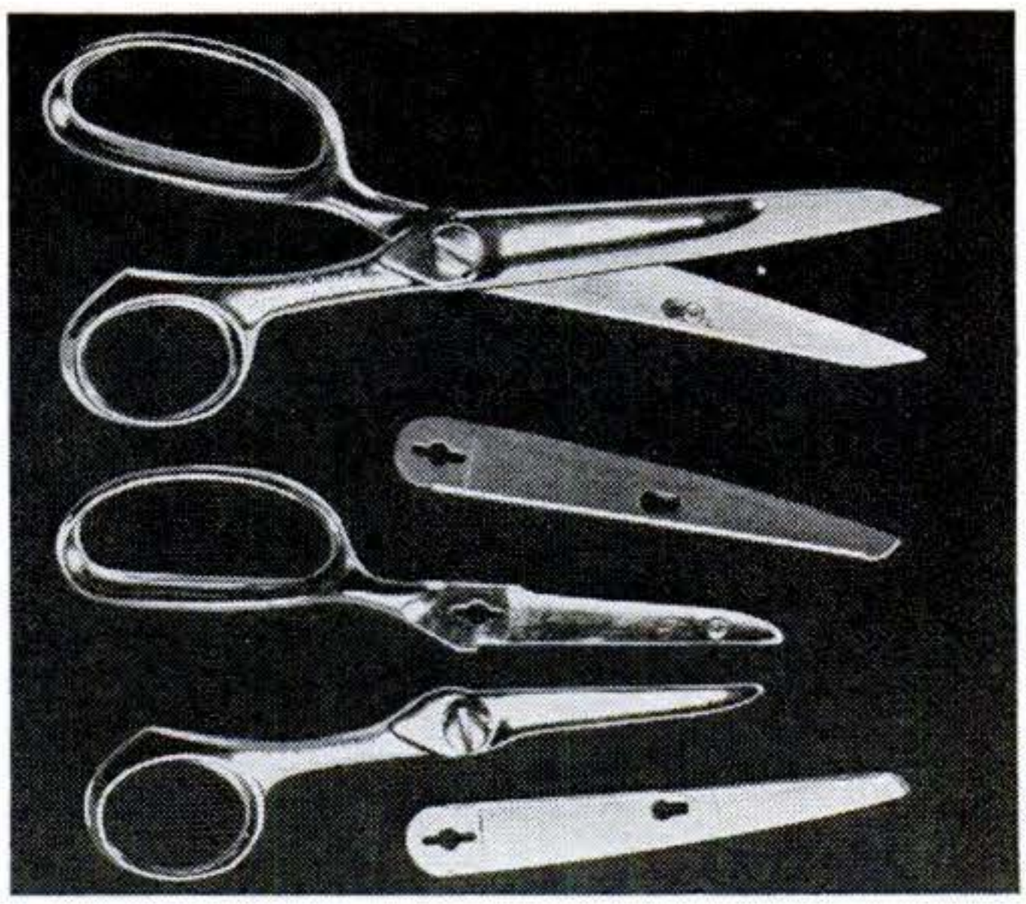
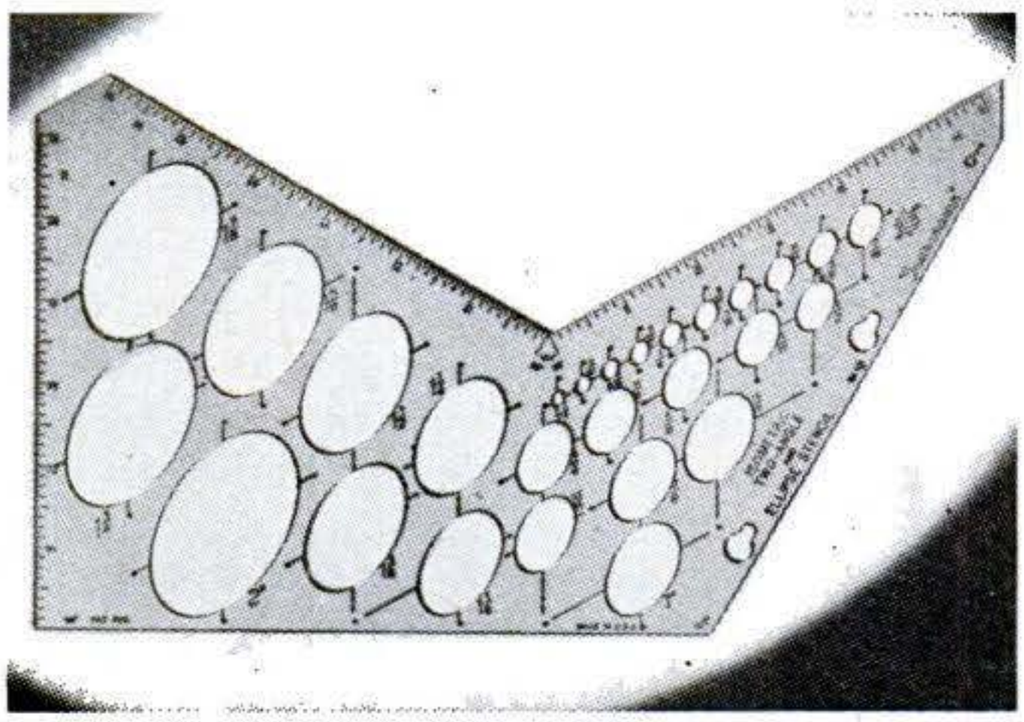


Spare Blades for Scissors

WHEN the Change-a-Blade scissors become dull, new blades to replace the old ones cost less than sharpening. Loosen a pivot pin with a dime or screwdriver, and the cutting edges separate from the handles as in the lower part of the picture. Insert a fresh set, tighten the screw, and the parts are locked securely together, as at top. Blunt, beveled, and sharp-pointed blades may be exchanged, providing several pairs of scissors in one. Tension is adjustable. The BMC Manufacturing Co., Binghamton, N. Y., sponsors the innovation.



Stencil Aids Draftsmen

PICTORIAL, easy-to-understand, engineering plans are made simpler to draw by the new Instrumaster stencil for isometric drafting. Cutout guides of 27 sizes yield expertly proportioned ellipses to represent circles; and ruler edges at correct angles lay out straight lines. The result is a drawing as the eye sees it. John R. Cassell Co., New York, distributes the labor-saving tool.

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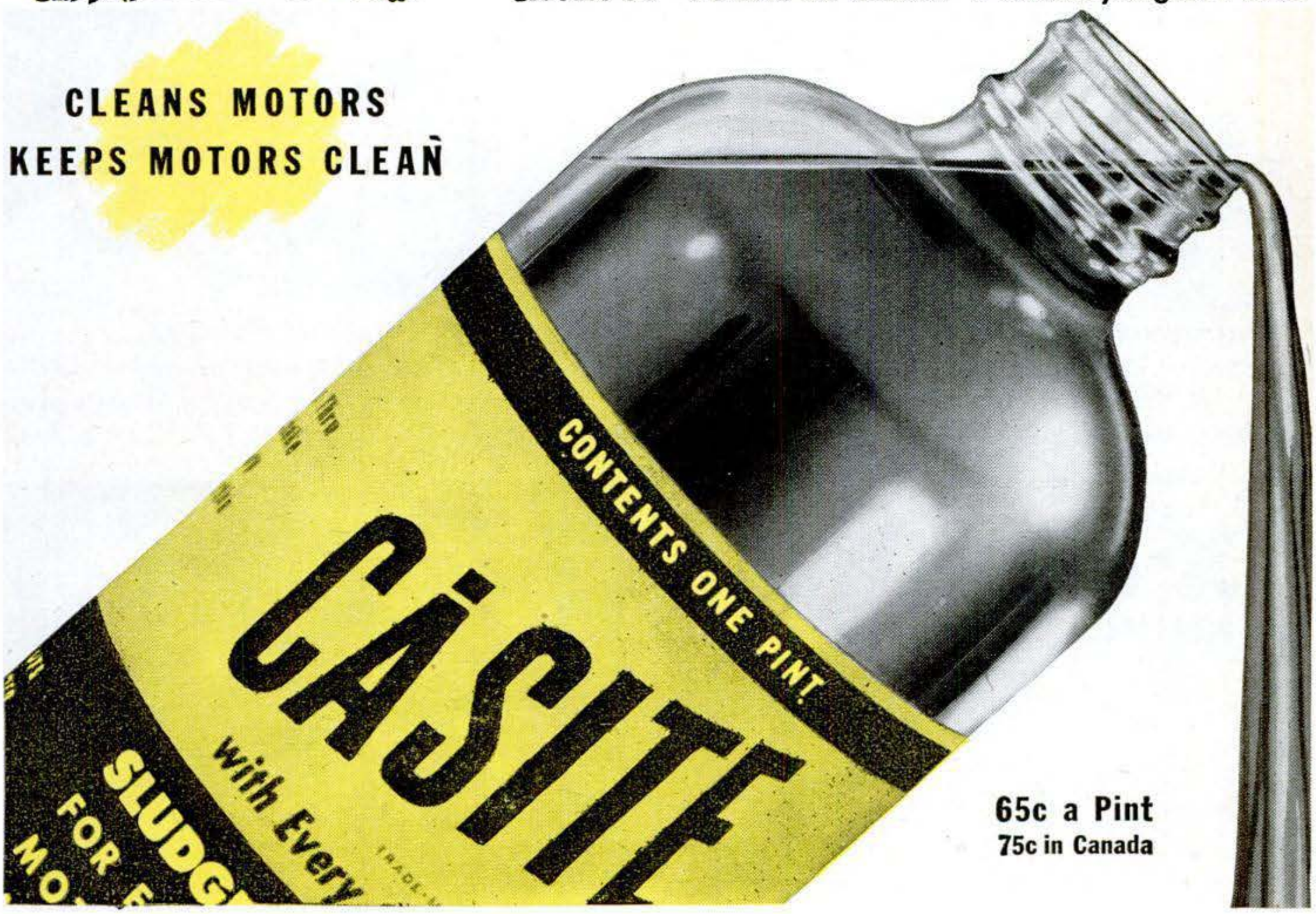

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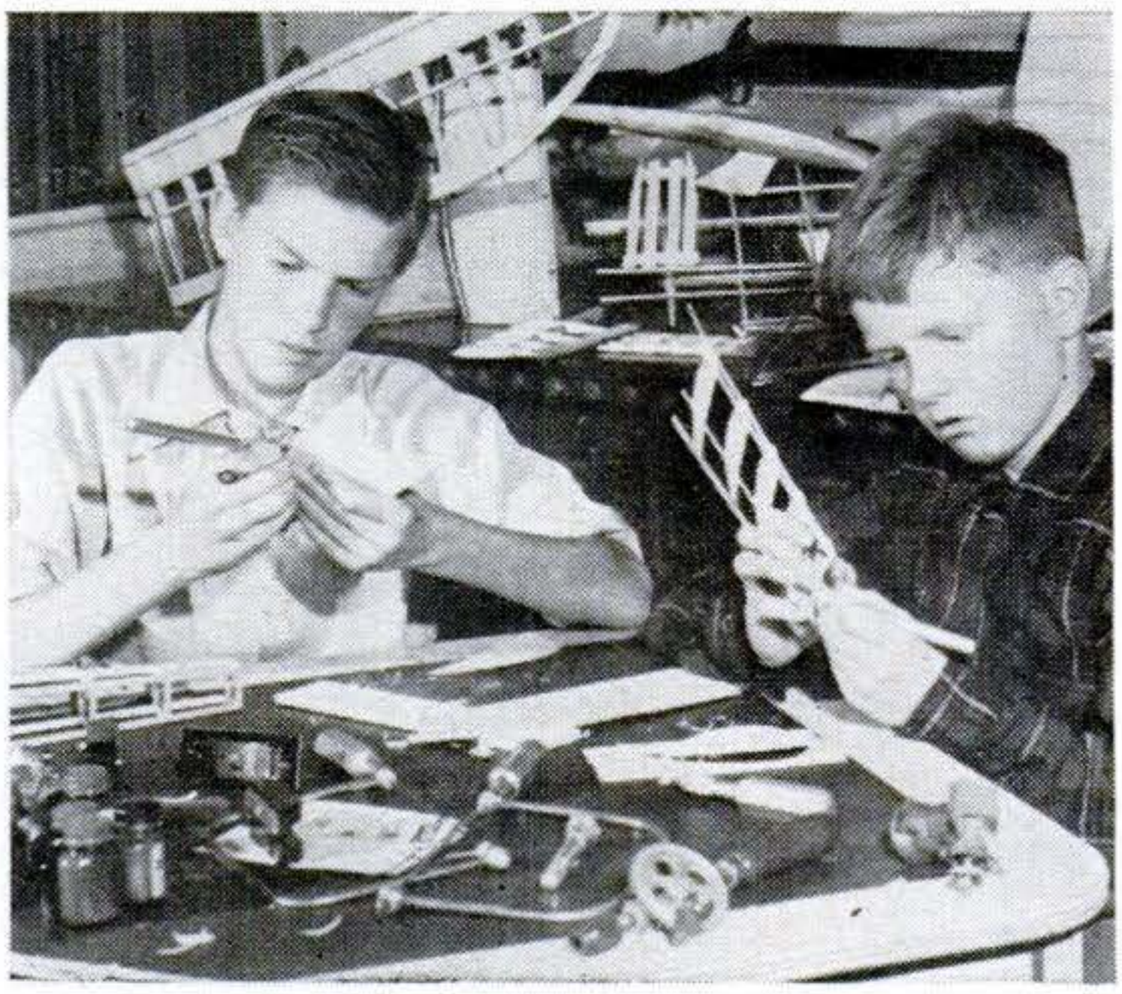
VERONICA R. STEVENS of Riverside, Illinois, made her "Paquita Dolls" hobby into a full-time business, for which she "uses X-acto tools daily and endorses them whole-heartedly."



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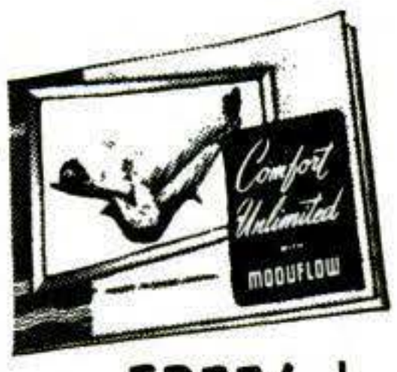

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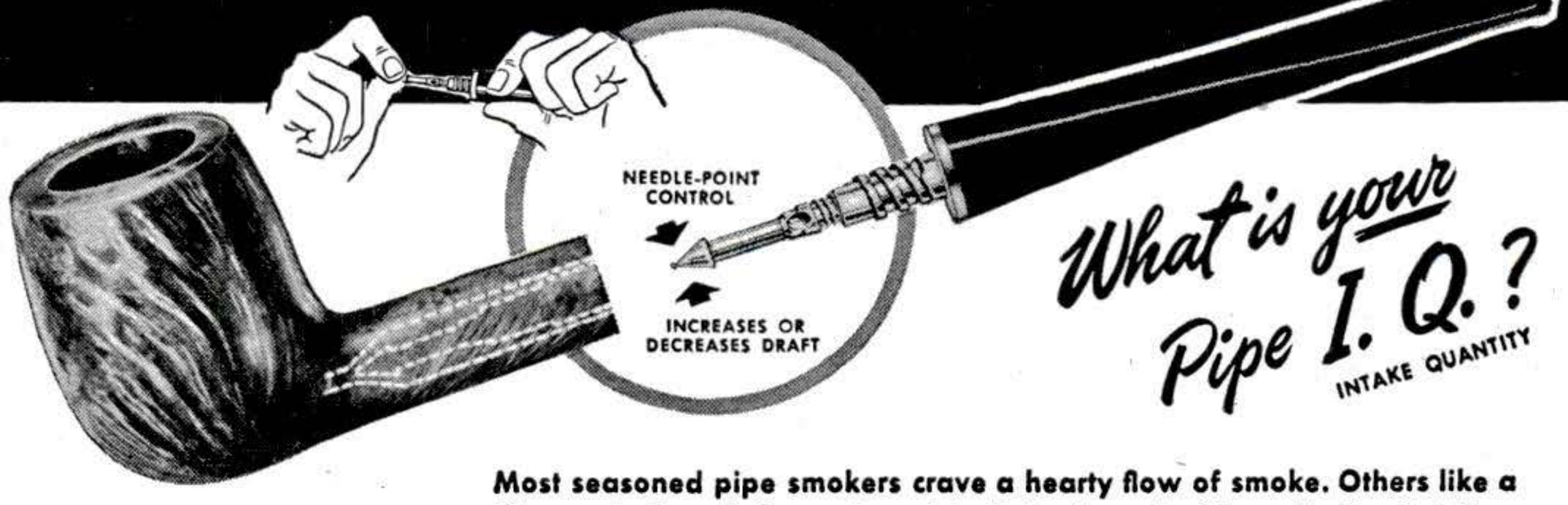

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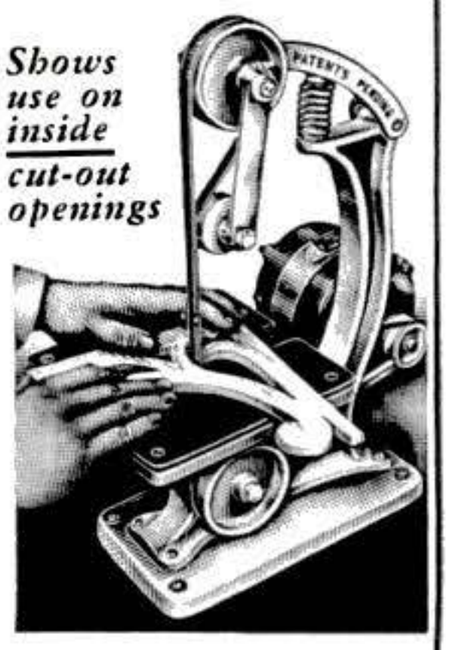

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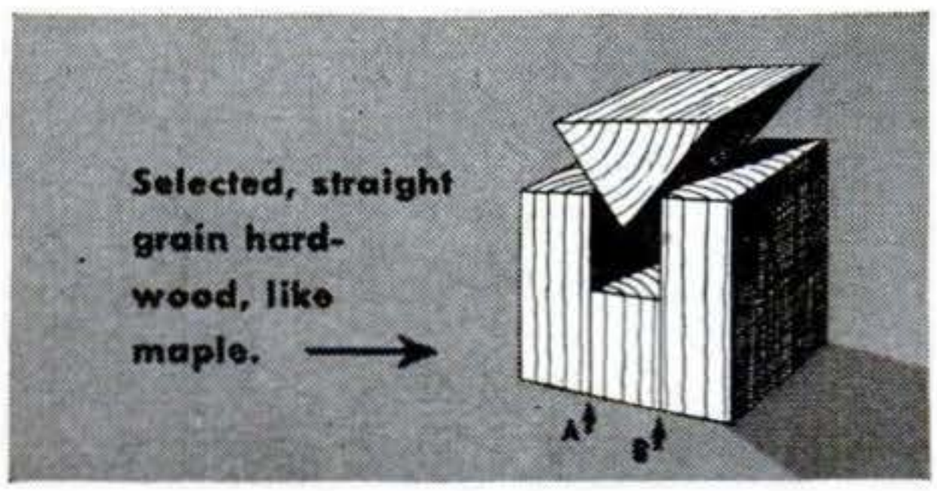
WORKSHOP WISDOM

How to Test Glues

AS SHOWN below, glue three pieces of wood together. Glue one joint (A) with Cascophen and the other joint (B) with any other type glue.



After the glues have set, boil test block for three hours (the Army test for aircraft plywood). Then, when the test block is cool enough to handle, drive in wedge as shown.

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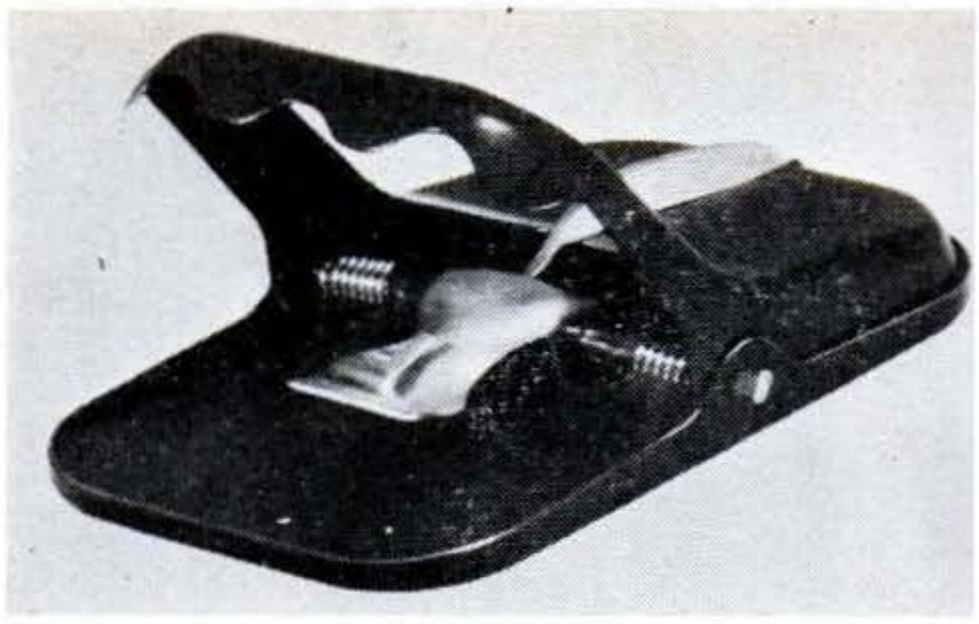
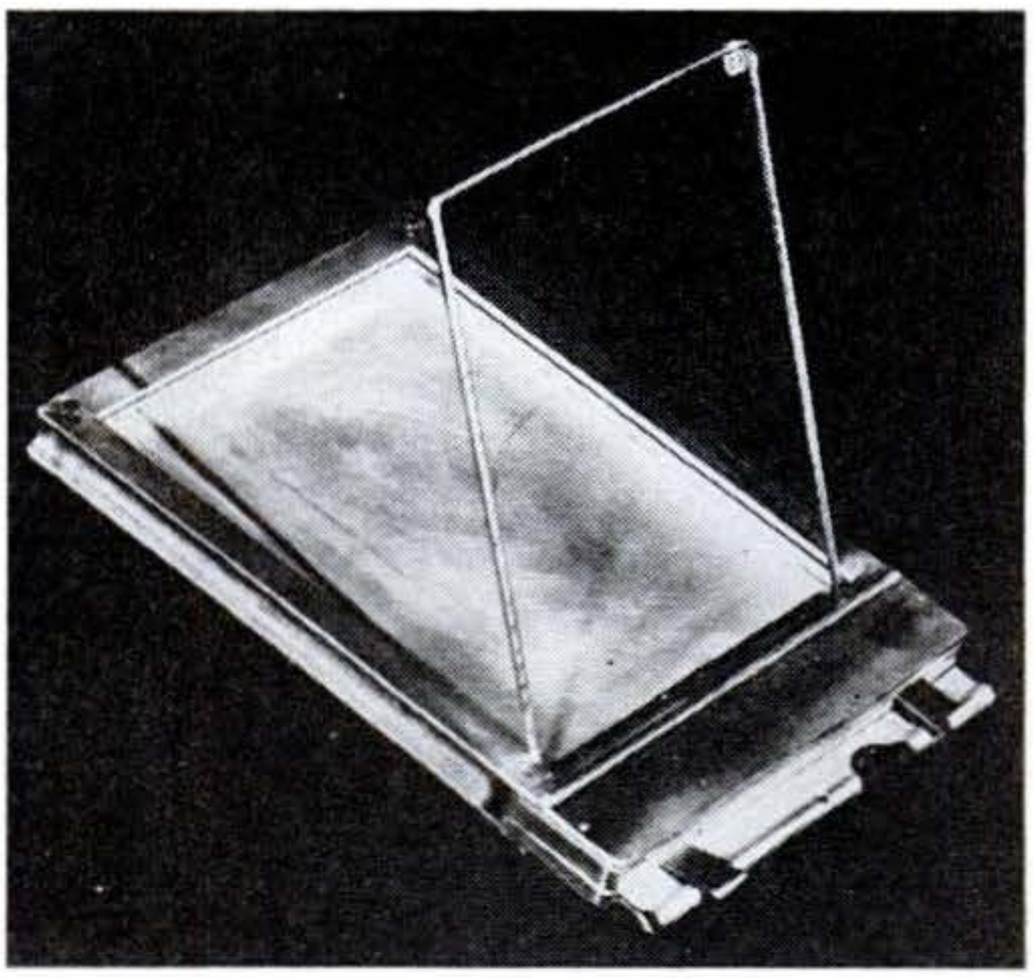


Safety-First Mousetrap

CLEVER design assures catching mice, not fingers, in the Hell Cat trap, above. Pressing one end of its seesawing, V-shaped top opens the jaw at the other end, to the "set" position shown. After a mouse has sprung the trap by nibbling at the bait, squeezing the "remote-control" end a second time releases the dead body for disposal, without need of handling. All-metal construction makes the mousetrap, a new product of Eagle Industries, Chicago, durable and easy to keep clean. A similar rat-trap is available.



Handy Film Holder

AUTOMATIC slide locks prevent accidental exposure in a cut-film holder introduced by Grover Photo Products, Los Angeles. Indestructible stencils, on convenient hold-down clips, imprint news pictures with neat numbers to keep descriptive data straight. Other features of the all-metal holder are designed to require a minimum of film-handling in the darkroom.

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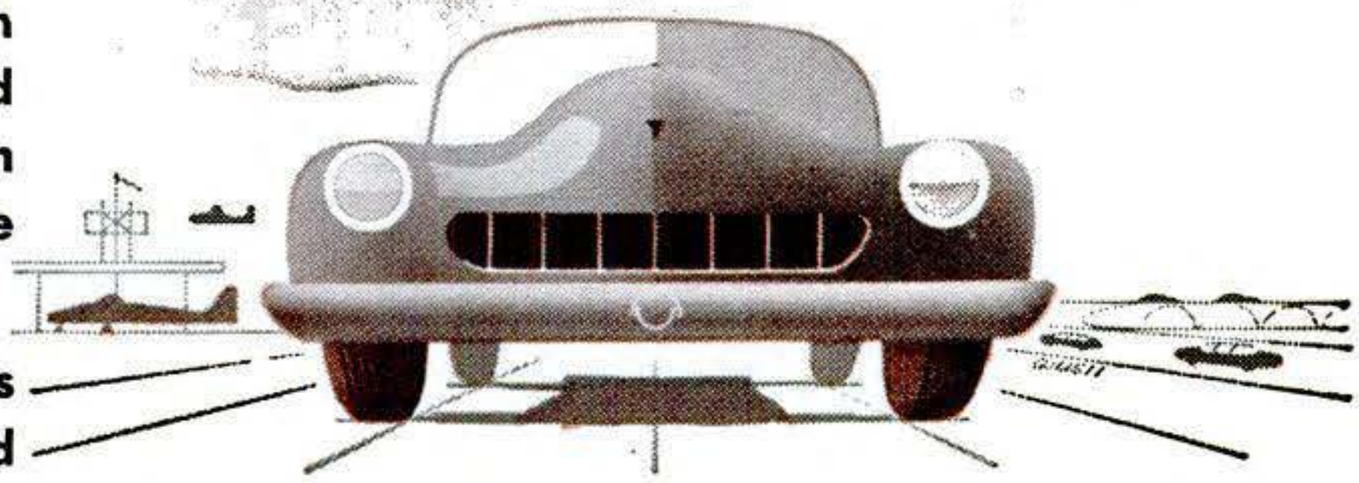
Dependable CHAMPION

AMERICA'S FAVORITE SPARK PLUG

When the American public, through its buying habits, indicates a decided preference for *any product*—you can be certain that it has merit above all others.

Dependable Champion Spark Plugs are in this enviable position, and are preferred and purchased by more motorists than any other spark plugs. Champion Spark Plug Company, Toledo 1, Ohio.



FOLLOW THE EXPERTS

DEMAND DEPENDABLE CHAMPIONS FOR YOUR CAR

Listen to the CHAMPION ROLL CALL, Harry Wismer's fast sportscast every Friday night, 9:55 EST over the ABC network

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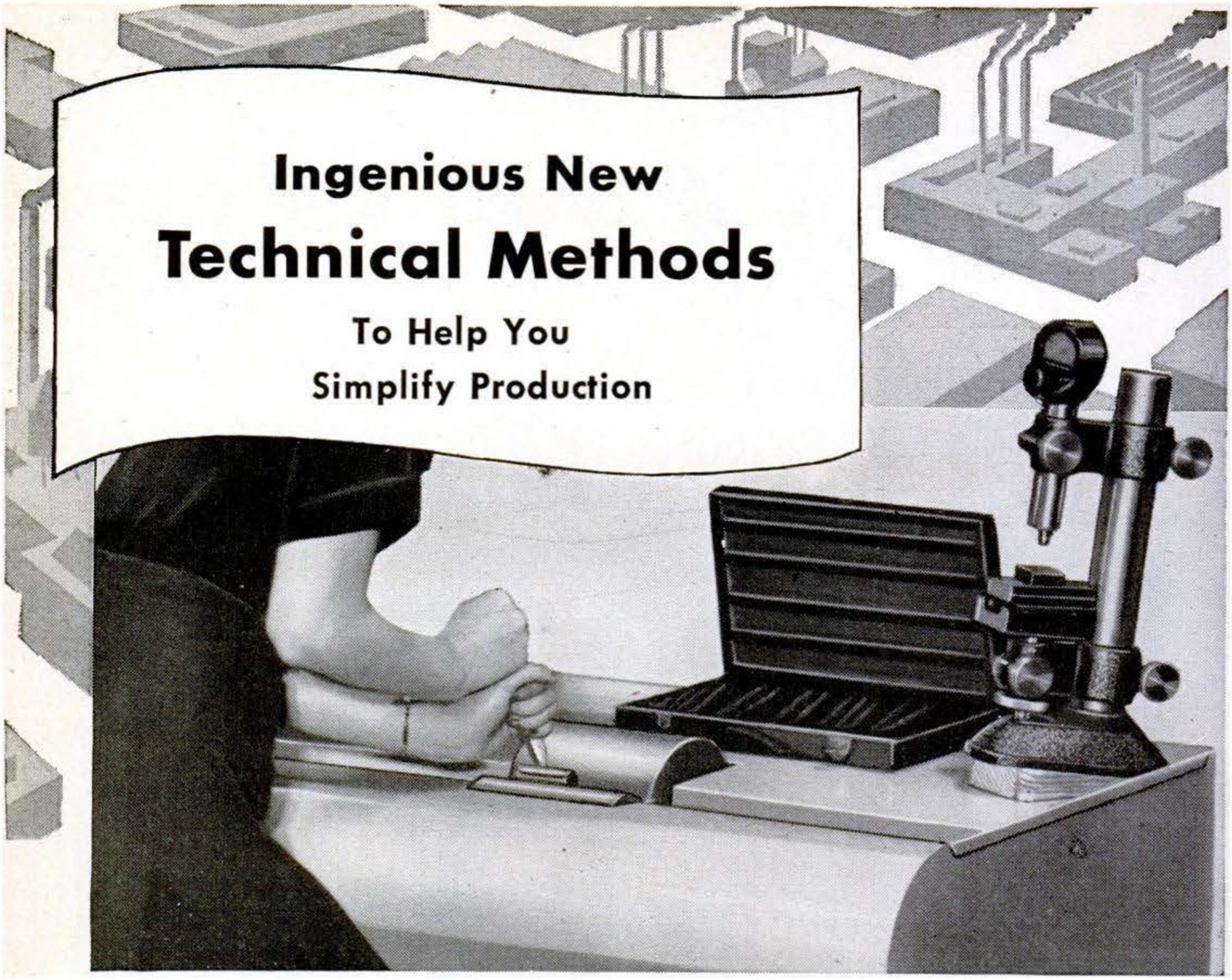
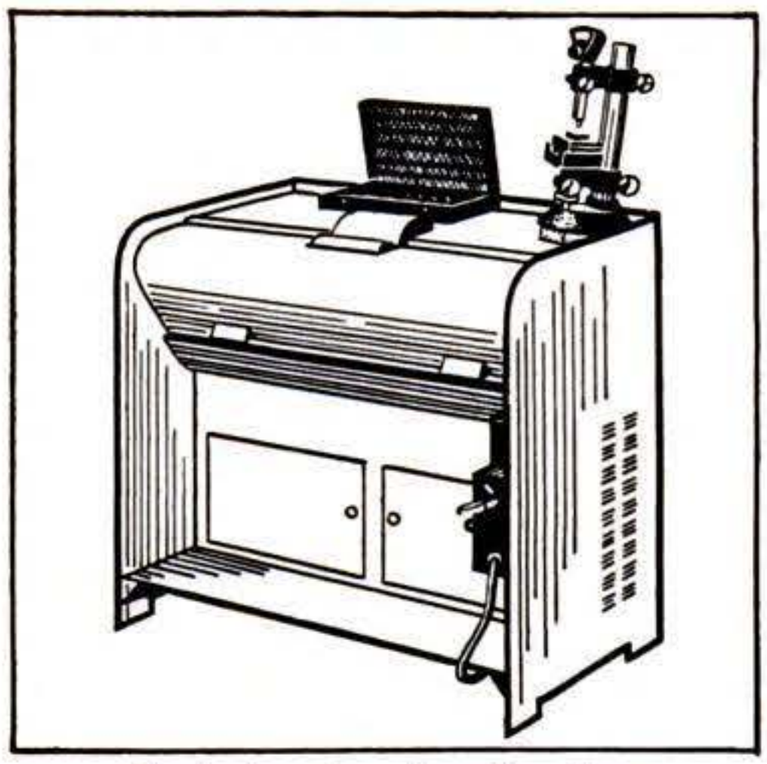


New Centerless Lapping Machine Gives Precision of Less Than 2 Micro-Inches!

Now it's easy to lap cylindrical pieces—quickly—accurately—without specialized operator skill! The new Size Control Centerless Lapping Machine handles pieces from .010″ to 10″ diameter without costly set-ups.

The operator merely holds piece between lapping rolls with stick. Pressure applied determines quantity of metal removed. Small roll turns piece at slow constant rate. Large roll turns more rapidly to remove minute quantities of metal. Ideal for lapping oversize gages, worn gage plugs to next smaller size, bearings, bushings or shafts. Roll speeds easily changed. Adjustable for tapers.



Centerless Lapping Machine

Ideal also to save time on the job, is chewing gum. The act of chewing aids the workers' concentration; seems to make work go easier. Furthermore, chewing gum may be used even when both hands are busy—increasing worker safety—and reducing work interruptions. That is why many plant owners have made Wrigley's Spearmint Gum available to all.

You can get complete information from Size Control Company
2500 Washington Blvd., Chicago 12, Ill.

AB-58

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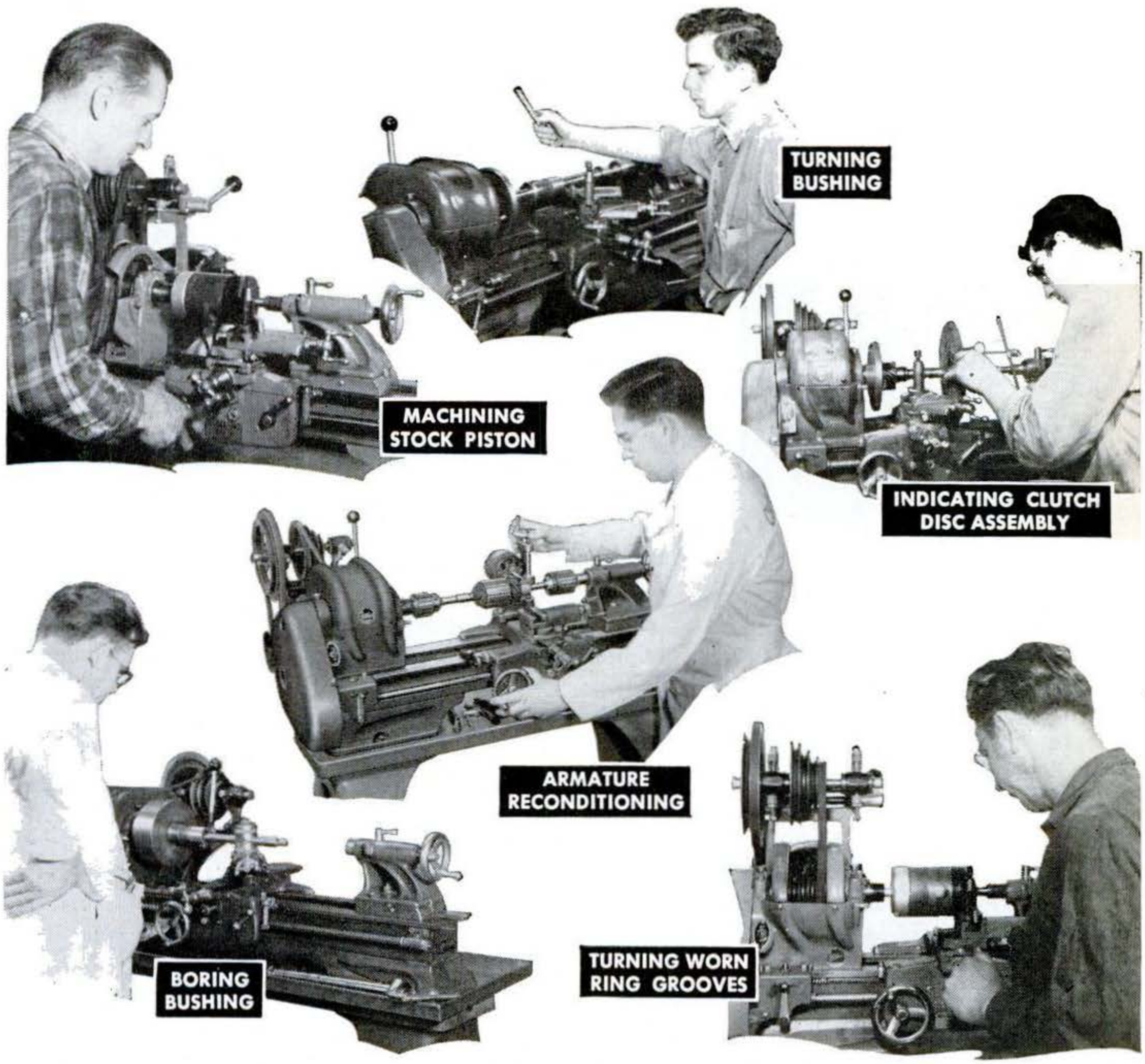


Atlas LATHES Speed Up Auto Servicing

Garages and automotive shops all over the country are rapidly equipping with Atlas lathes. It's a profit hint to consider if you operate or work in such a shop — something to remember as a valuable use for an Atlas in your home shop.

Six typical Atlas lathe servicing jobs are shown above. All told there are 44 different ways to keep an Atlas busy in modern automotive repairing.

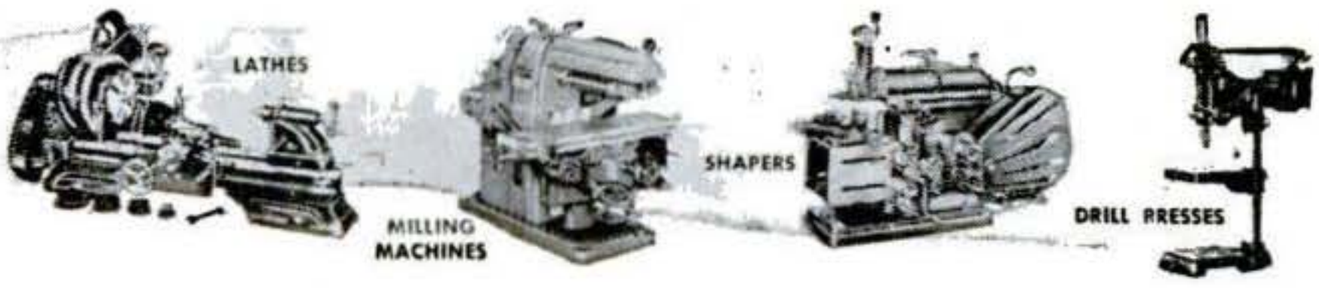
Atlas lathes are preferred for such work because they are: (1) compactly engineered for minimum space (2) easy to set-up and operate (3) work to close tolerances (4) extremely versatile (5) ruggedly built for years of precision service (6) available at low cost.

Ask your Atlas distributor for complete details and delivered prices.

SEND FOR FREE CATALOG

Get complete information about Atlas lathes, drill presses, millers, shapers, and the many inexpensive accessories available for Atlas tools. Send for this free catalog today. Atlas Press Co., 355 North Pitcher Street, Kalamazoo 13D, Michigan.

Atlas 4 TOOL TEAM



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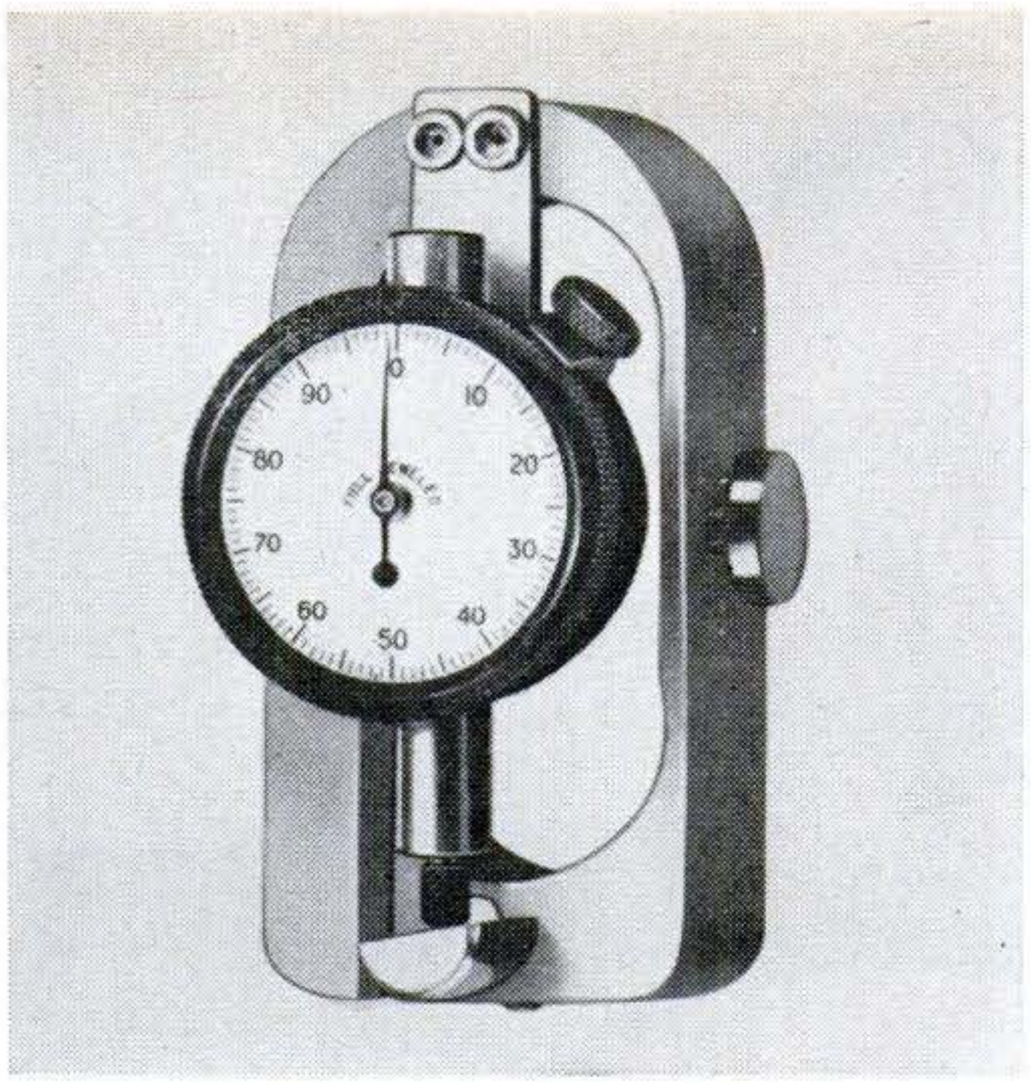
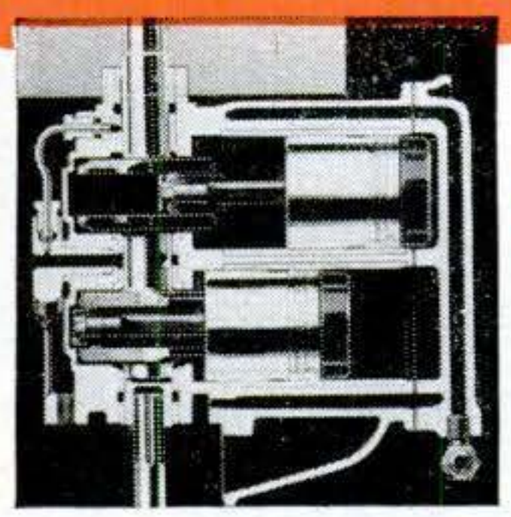
Juicer Has Detachable Parts

REAMER, funnel and juice cup of the Juice-O-Mat are detachable for easy cleaning. The reamer has indentations and fins that prevent pulp and seeds from passing into the receptacle. All pressing parts and the cup are of Tenite plastic, which is not corroded or discolored by citrus juices.



Pressure Gauge for Tight Spots

SMALL enough to fit into places hitherto inaccessible, the new Dillon mechanical pressure gauges work in all kinds of clamps and have ranges from 100 to 10,000 pounds. They will check pressure between spot-welding electrodes and moving rollers, and will test tension in moving wires.



SIMPLICITY OF
TWIN CYLINDER CONSTRUCTION
CONTRIBUTES TO JOHNSON'S FAMOUS
DEPENDABILITY

It is *Johnson* that gives you the simplicity and DEPENDability of twin-cylinder construction with the liquid smoothness of Perfected Alternate Firing. Plus Reverse. Plus Dual Carburetion. Plus Ready-Pull Starter. All these (and more) are *Johnson* developments. 5 great models for '47 —a size for every outboard need. See your Johnson dealer for advice on the right motor for your boat. Look for his name under "Outboard Motors" in your classified telephone directory...

FREE HANDY CHART: Write. Complete data on 1947 line.

JOHNSON MOTORS, 500 PERSHING ROAD, WAUKEGAN, ILL.
Johnson Motors of Canada, Peterboro, Canada

JOHNSON
SEA-HORSES

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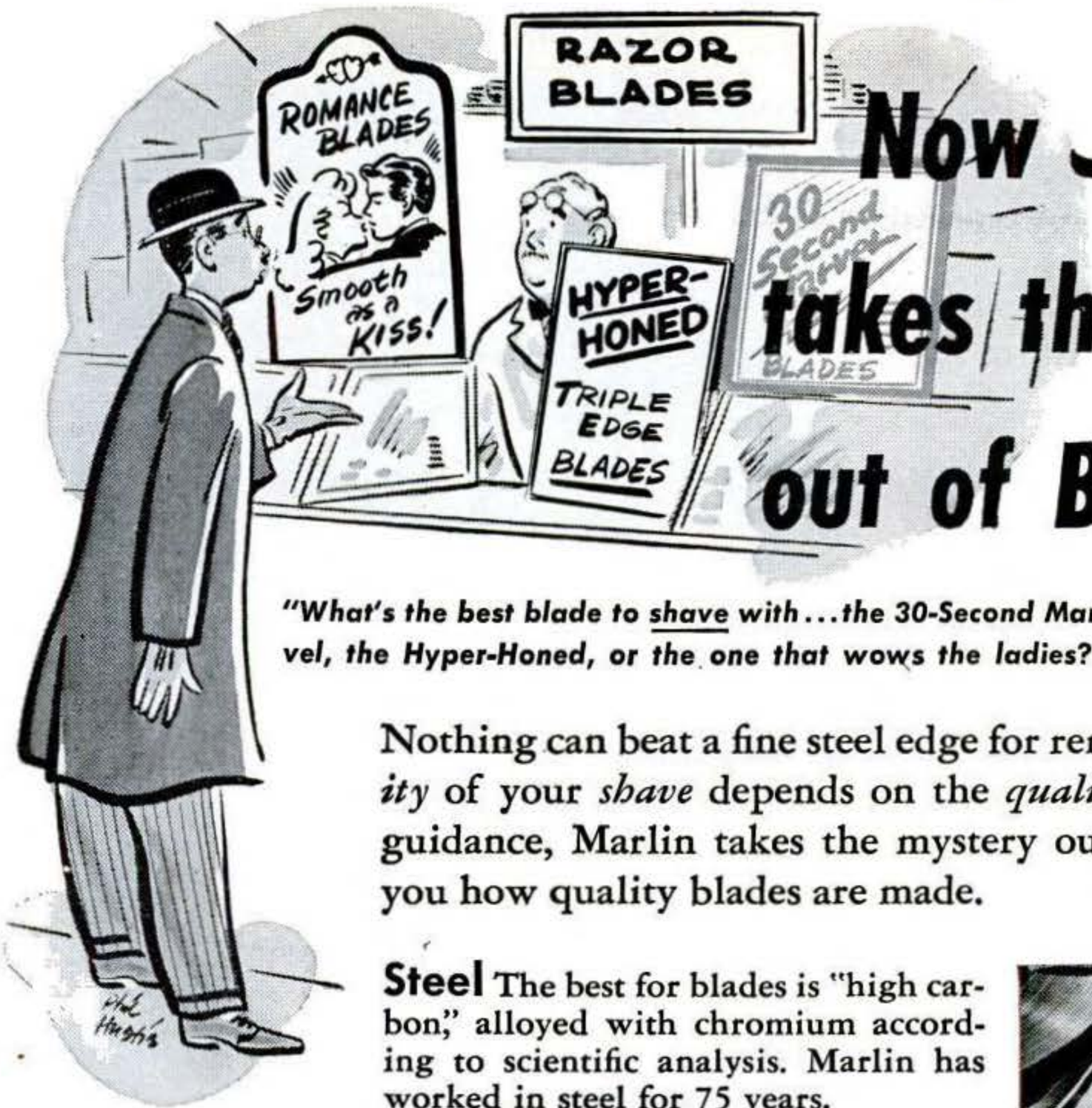
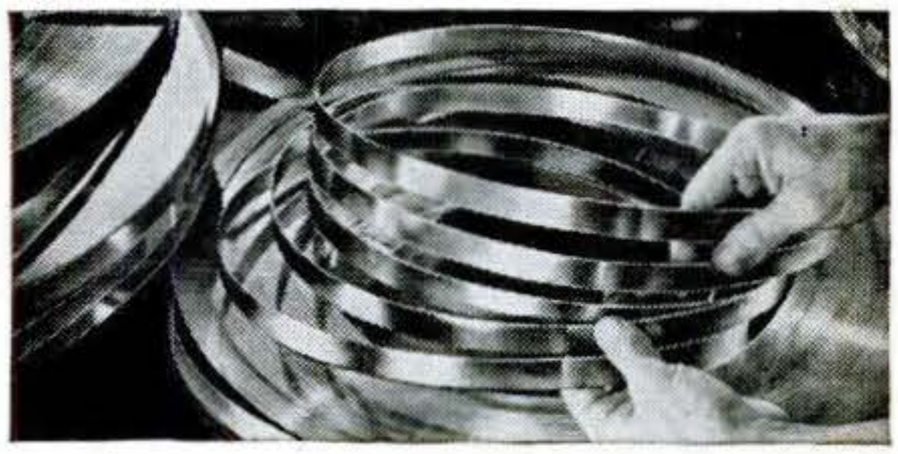


Now *Marlin* takes the MYSTERY out of BLADE buying!

"What's the best blade to shave with...the 30-Second Marvel, the Hyper-Honed, or the one that wows the ladies?"

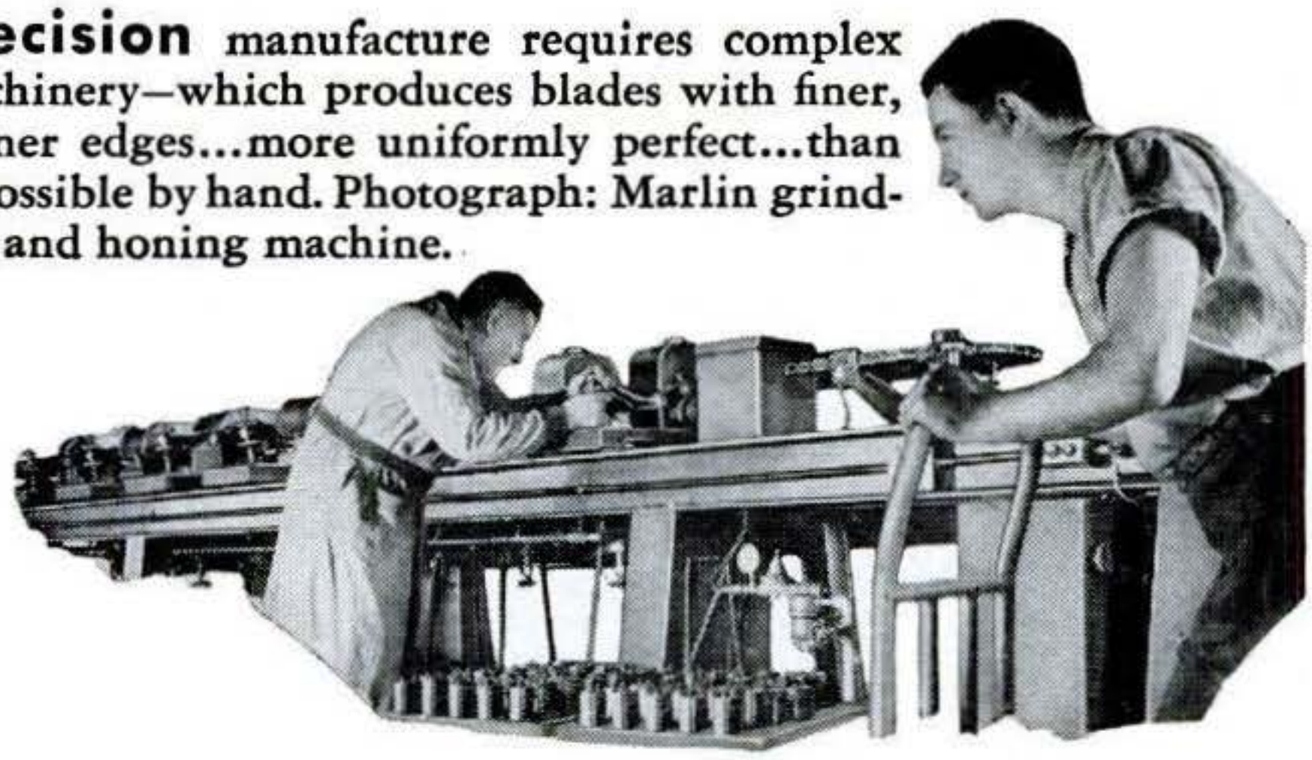
Nothing can beat a fine steel edge for removing whiskers. The *quality* of your *shave* depends on the *quality* of your *blade*. For your guidance, Marlin takes the mystery out of blade buying...shows you how quality blades are made.

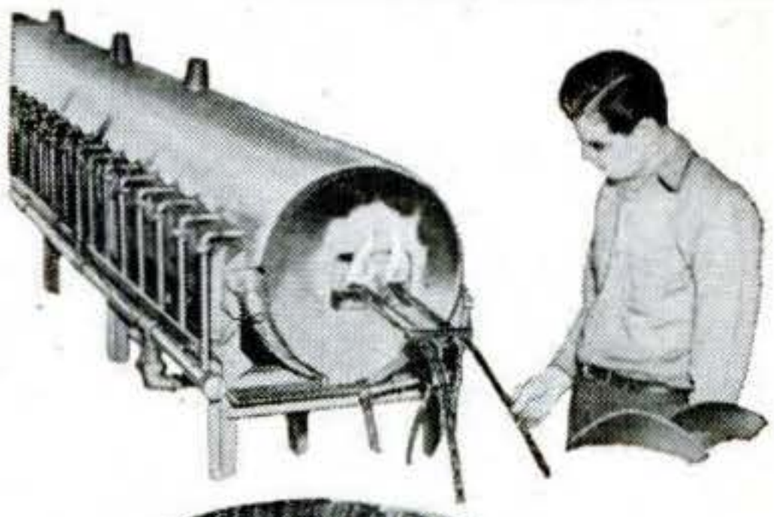
Steel The best for blades is "high carbon," alloyed with chromium according to scientific analysis. Marlin has worked in steel for 75 years.

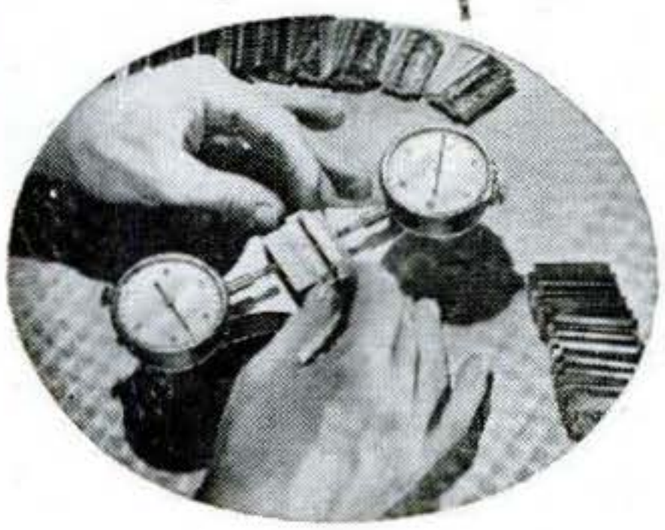


Tempering makes steel hard and tough. From bulky ingot to ribbon-like strip, blade steel is heat-treated again and again. Final tempering "sets" the metallic structure to take a sharp tough edge.

Precision manufacture requires complex machinery—which produces blades with finer, keener edges...more uniformly perfect...than is possible by hand. Photograph: Marlin grinding and honing machine.







Inspection is continuous with top quality the goal. Shown is one of the precision instruments which check dimensions and "centrality"—*insuring perfect fit in your razor.*

Actual shaving Tests are conducted among changing groups of shavers. Results give the final verdict on quality.

TRY MARLIN BLADES AT OUR RISK! We believe that Marlin Blades are the best that can be made. If you don't agree, we will cheerfully refund your money.

DOUBLE OR SINGLE EDGE

THE MARLIN FIREARMS COMPANY • Fine Guns Since 1870

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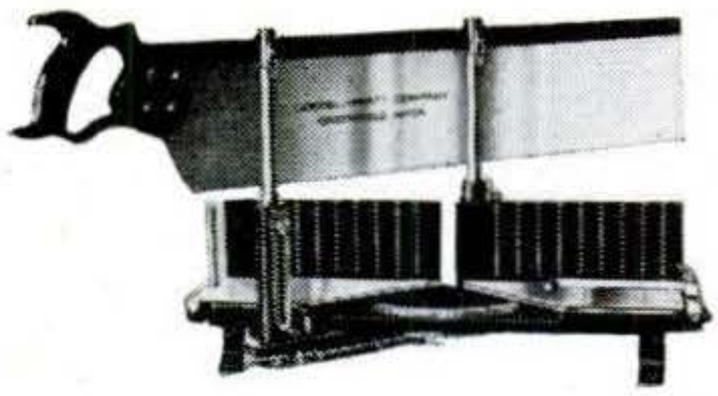
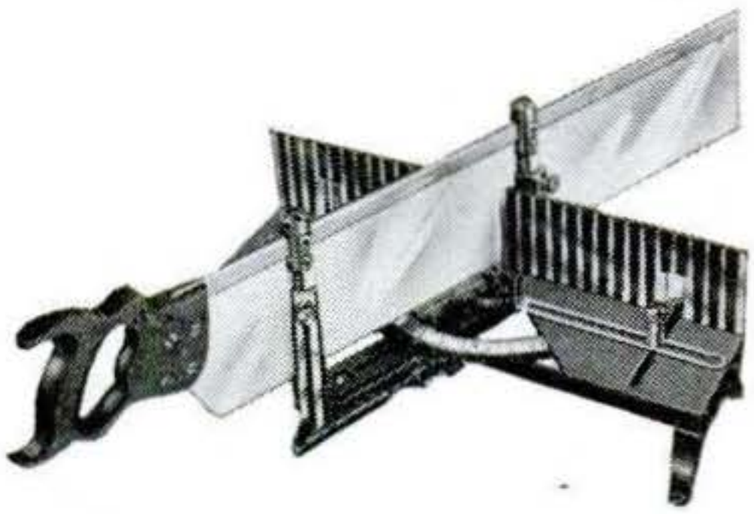
Smooth . .

BALL-BEARING ACTION *plus* DEPENDABLE ACCURACY





Ball-bearing saw-guides and saw-carriages to make work easier, positive adjustment for cutting angles to eliminate errors, graduated arcs and index plates to produce near-precision cutting, all-steel construction to last a lifetime — these are but a few of the many outstanding advantages offered by Millers Falls mitre boxes.

Like all Millers Falls products, these mitre boxes are quality-constructed throughout. You'll be surprised how much more simple, how much more accurate they can make your work. See them at your dealers.

MILLERS FALLS COMPANY
Greenfield, Massachusetts

One thing in common — Quality!

MILLERS FALLS TOOLS SINCE 1868

We met in the Army

now I demand

Over 90 million yards of Reeves Army Twill were purchased by Uncle Sam during the war. It has great tensile strength—resists tearing, snagging and scuffing. Its dyes are fast to sun, water and perspiration. Sanforized Shrunk*, it tailors smartly, holds its lines. It comes in a wide variety of colors. Demand Reeves Army Twill for better, more economical work clothes.
*Residual shrinkage less than 1%.

REEVES BROTHERS, INC.
54 Worth Street, New York 13, N. Y.

TORNADO GAS TORCH

The Modern Way of Soldering

Ideal for hard and soft soldering. Will heat quickly; solder will flow freely and smoothly. No compressed air required. Nothing to pump. Self-adjusting. Safe. Economical. Can be used for annealing small parts and bending metal parts. Generates a heat of 1700° Fahrenheit. Simply connect to any illuminating gas jet with a rubber hose and operate. Tornado Torch No. 119 comes with three (3) tips, (1/8", 1/4", 3/8" blast).

The Tornado Gas Torch No. 119, complete with three tips, is $2.95. See your dealer or order direct. Send check or money order—post paid.

Robco Corporation, 204 E. 44th Street, New York 17, N. Y.

DIE-LESS DUPLICATING

Many small parts can be formed without dies, to duplicated accuracy of .001" with DI-ACRO Precision Machines. — Benders, Brakes, Shears. Save die expense and time delay. Ideal for experimental and research work, making samples, models, etc. as well as regular production runs.
Write for descriptive literature.

O'NEIL-IRWIN MFG. COMPANY
342 8th Ave., Lake City, Minn.

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ALL YOURS with an Evinrude

Check every quality and feature you want in a modern outboard motor . . . chances are, you'll find that Evinrude offers every one . . . *and more!* Each developed and perfected the sure and steady way . . . through 38 years of progressive engineering, experimenting, *proving.* That background is worth remembering—when you choose an outboard motor!

Want Sure Starting? Fine! That's an Evinrude "specialty" . . . always, on every model, it's mechanically *built right in!*

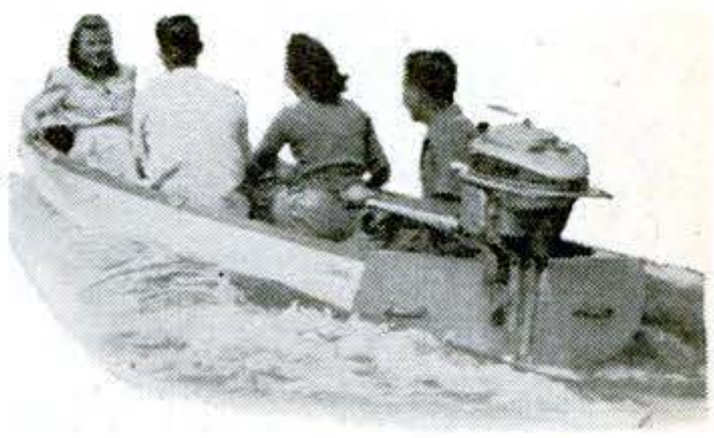
Co-Pilot Steering! On every model the "unseen hand" that grips when you let go . . . holds the motor on the course you set.

Operating Ease! — with controls so simple and troubleproof that even youngsters handle an Evinrude easily and capably.

Quiet! Smooth! Perfected underwater silencing buries exhaust fumes and noise. Motors float in vibration-absorbing bearings.

Slow Trolling Speed!—enables you to check right down to a slow trolling glide without choking, stuttering or stalling.

Full Reverse! On two great fishing models—and new *Weedless Drive* enables you to drive through thickest weeds.



Four-cylinder Performance! Nothing like it for smoothness, thrilling responsiveness — and Evinrude offers it in three models!

Widest Range of Models! The right motor, for every boat, every service. Seven models, all with O.B.C. horsepower certification.

It all adds up to finer *performance!* And back of every Evinrude is the priceless advantage of organized, responsible, nationwide *service* . . . available everywhere through a veteran organization of selected dealers. *See your Evinrude dealer* — look for his name in your classified phone directory under "Outboard Motors". *Catalog free!* Address, EVINRUDE MOTORS, 5457 N. 27th St., Milwaukee 9, Wisconsin

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FIRST IN OUTBOARDS • 38TH YEAR

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"Typical Hawaiian Wiggler Catch"

Frank Vestal with bass caught on Hawaiian Wigglers in Arkansas

—writes Memphis Newspaperman

Dear Fred:

"This creel limit of Kentucky bass from Cache River, Ark., is typical of Hawaiian Wiggler achievements in the Mid South. Frankly, most of the bass I have caught in the past year have been caught with either the No. 1 or No. 2 Hawaiian Wiggler. My friends swear by these famous baits that are effective both in still lakes and running streams."

—Frank Vestal, Memphis Commercial Appeal outdoors writer.

Write for Free Catalog

Contains many interesting letters and photographs of catches made with Hawaiian Wigglers, Jitterbug, my famous surface bait, and my new Hula Dancers. No mail orders.

No. 1 Deep Running Hawaiian Wiggler— $1.10

FRED ARBOGAST & CO., 1703 North St., Akron 8, Ohio

The *KALART* *Compak Passive* SPEED FLASH

FOR OWNERS OF POPULAR PRICED CAMERAS WHO WANT TO MAKE *Speed Flash* PICTURES LIKE PROFESSIONALS DO!

$8.95 Complete Federal Taxes Included

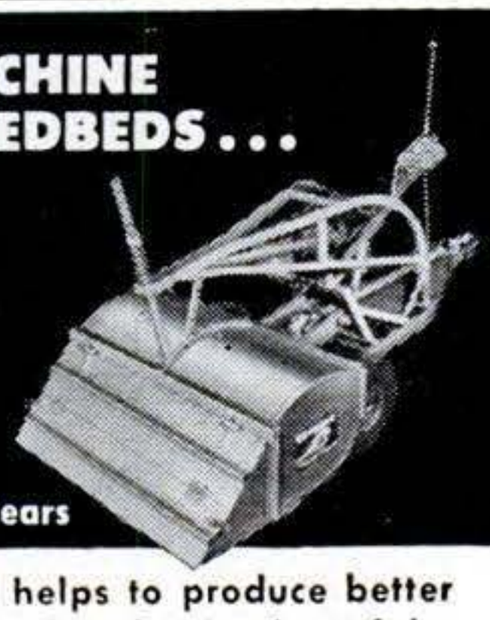
Pocket size! Light weight! Built on the proven principles that have made the KALART SPEED FLASH line famous for dependable performance. Has a specially designed "concentrating" reflector for midget bulbs. Grand for black and white—excellent for color—the Compak Passive is ideal for Kodaks, Anscos, Argus and many other popular cameras.

See the KALART Compak today at all better dealers or write KALART Dept. PS-3 Stamford, Conn. for free descriptive literature.

KALART

A BETTER MACHINE for BETTER SEEDBEDS...

THE **SEAMAN TILLER**



Used by U. S. Dept. of Agriculture for Many Years

The SEAMAN TILLER helps to produce better yields by: (1) thorough pulverization of the soil; (2) hastening and promoting earlier and more complete germination of seed; (3) distributing plant food uniformly and effectively throughout the *growing area* of the seedbed; (4) helping to increase the supply of nitrogen through complete seedbed aeration; (5) eliminating "air pockets" and hard plow soles that usually retard plant growth; (6) helping to destroy crop pests and diseases such as grubs, cut-worms, beetles, grasshopper eggs, weevils, borers, potato scab and certain varieties of fungus; (7) providing more effective weed control; (8) reducing soil erosion.

If you want to know HOW all this is possible, write for free copy of "Questions and Answers" booklet . . . and see your local SEAMAN dealer or write us direct.

SEAMAN MOTORS, Inc. 311 North 25th Street Milwaukee 3, Wis.

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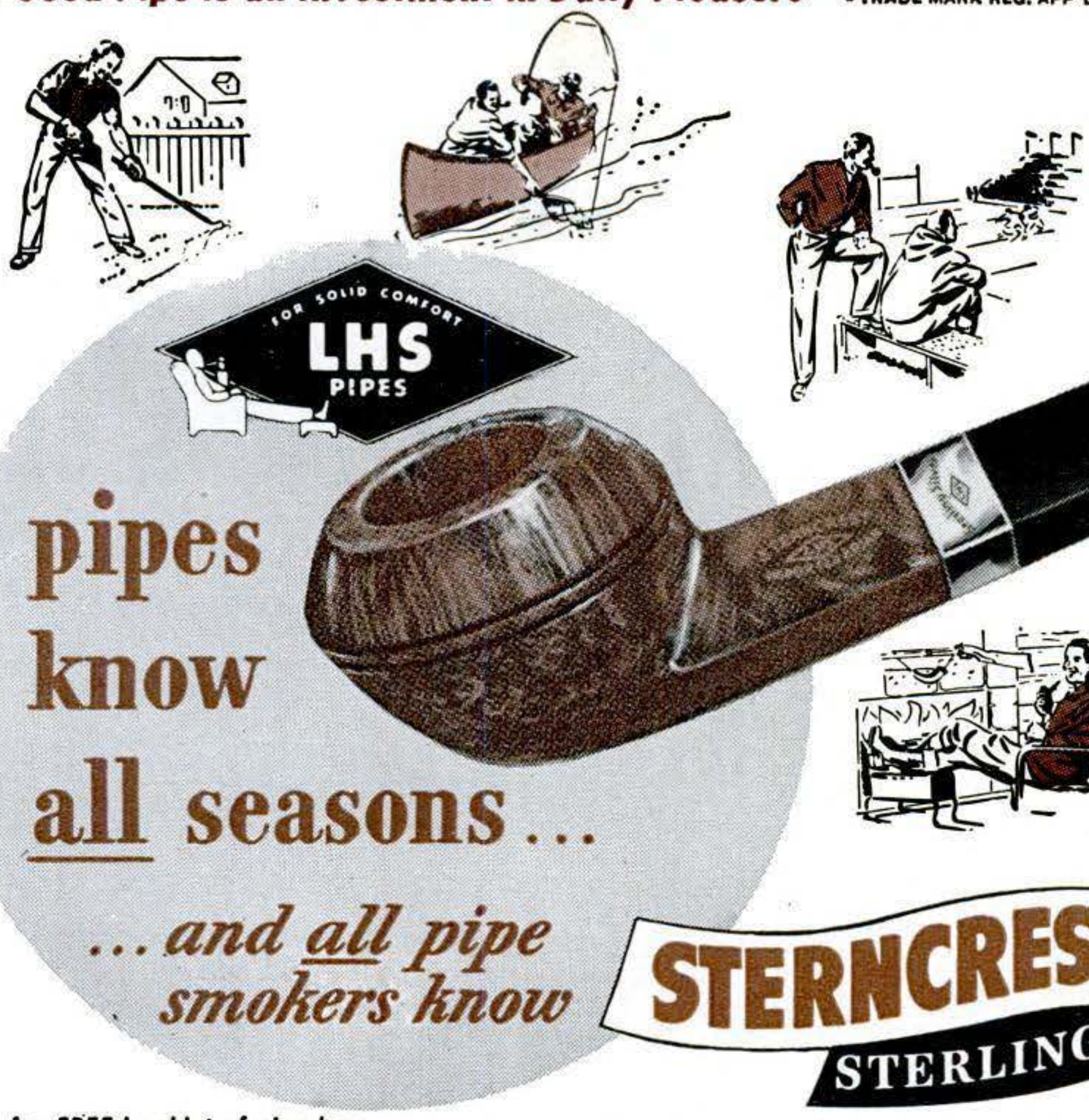
*"A Good Pipe is an Investment in Daily Pleasure" *TRADE MARK REG. APP'D FOR



pipes know all seasons...

...and all pipe smokers know

STERNCREST STERLING

$5 Imported Briar. Sterling Silver Band. Dozens of other handsome models, satin-burnished or antique finish.

Model #88
Appr. 4/5 of actual size

No change in Sterncrest Sterling's price or quality since it was first introduced. It's the same fine pipe now as before the war. To be sure of the best pipe value, whether you pay $25 or $1, look for LHS—the sign of a perfect pipe for 50 years. At your dealer's.

FOR CIGARETTE SMOKERS: "Smoke all you like—like all you smoke" with Zeus Cigarette Filter Holder.

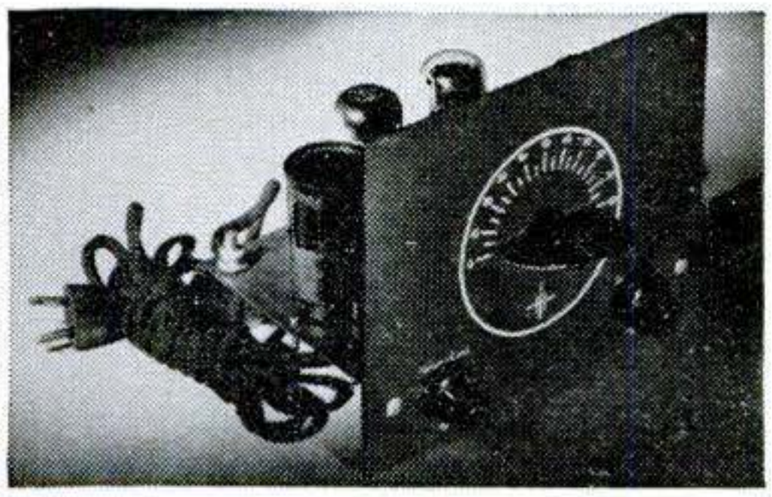
Write for FREE booklet of pipe lore: "Pipes for a World of Pleasure"

L & H STERN, Inc., Dept. 1X, 56 Pearl St., Bklyn 1, N. Y.

Hey, Fellows!

A REAL RADIO FOR ONLY $6.15

You Build It Yourself



BEGINNERS, STUDENTS! . . . Here's what you have always wanted—a low cost, foolproof, build-it-yourself radio (AC-DC) that's a top performer. Gain experience and confidence making it — fun using it. Ask for Kit R-3. Supplied less 3 inexpensive tubes, wire, solder, earphones for only **$6.15.**

Set of Tubes.....**$2.40** Phones.....**$1.95**

Five-tube AC-DC superhet, automatic volume control, true tone reproduction, Alnico magnet in speaker — many other features. Beautiful cabinet included. An excellent kit, all stations on broadcast band. Ask for Kit S-5. Cost, complete, less tubes, only **$14.45.** Kit of Tubes **$4.08.**

Six-tube, 2-band AC-DC Model Kit. Many top features that will interest more advanced radio students and enthusiasts. Kit also includes good looking plastic cabinet. Ask for Kit S-6-X. Cost, less tubes **$18.95.** Kit of Tubes **$4.80.**

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- Write: 242-B W. 55th St., N.Y. C. OR 323-B W. Madison St., Chicago

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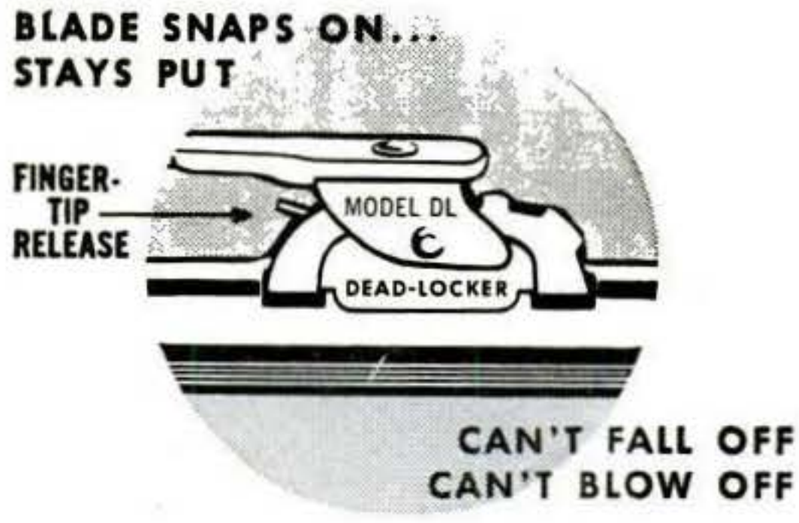
ANCO RAIN-MASTER

"Dead-Locker"

WINDSHIELD WIPER ARMS and BLADES



(A war-born invention—by ANCO—first for military aircraft—now for your car.)

DON'T SHOOT YOUR GAS-PUMP MAN!

He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car . . . in stormy weather . . . with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!

After all, it's *your* car to protect. So *you* remind *him*. Get RAIN-MASTERS ...patented features...original equipment on many makes of high grade cars and trucks . . . used in war—on our fighting tanks and trucks and ships and bombers too...because ANCO RAIN-MASTERS clean quicker, clean cleaner . . . last longer. May save you a costly smashup.

Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

THE ANDERSON COMPANY
Established 1918
GARY, INDIANA

RIDE TO WORK

Tired of waiting for streetcars, buses? Be your own transportation boss with a WHIZZER Motor on your bike. You'll go 125 miles and more on a gallon of gas—that's six miles for just one cent! Speeds up to 35 miles per hour . . . 2½ sturdy horsepower. Backed by eight years of progressive engineering. Fits any man's balloon tire bike.

FOR JUST ONE CENT

RIDE ONE AND YOU'LL BUY ONE!

ON A

WHIZZER

Whizzer Motor Company, Dept. 533, Pontiac, Michigan.

I enclose $99.97, which includes $2.42 Federal Excise Tax ( ) check or ( ) money order. Send me one WHIZZER Motor complete, ready for installation. If descriptive literature only is desired, check here ( ).

Name_____ City_____

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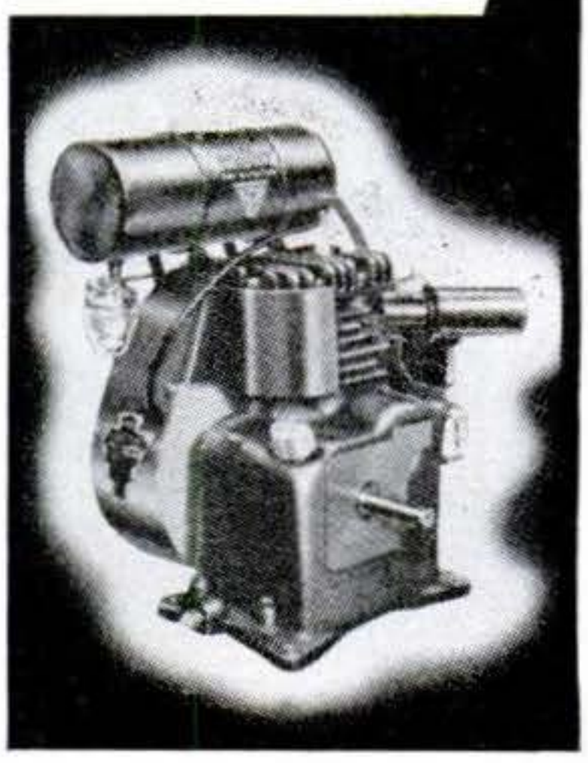
Everyone is a Mechanic

Buy Your Boy

A CLINTON ENGINE



Today is a day of mechanical achievements—as you and your dad liked horse power on the hoof, your son likes horse power built of iron. The Clinton Engine gives a wonderful education in modern engineering and machine design. It's a development of outstanding sturdy characteristics—1 to 2 H.P.—4-cycle—air-cooled for powering his implement of pleasure or work—

See your dealer—There is one in your community—or write—Dept. 101 PS

CLINTON MACHINE CO.
CLINTON, MICHIGAN

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RIDE YOUR FAVORITE "HOBBY" WITH...

THE COMPLETE HOBBYCRAFT ASSORTMENT THAT FILLS EVERY NEED

Whether your favorite hobby is model building, wood carving, leather working, linoleum cutting, you'll find in the new King Kut knives, tools and blades such standards of design, workmanship and PERFORMANCE that will gladden your craftsman's heart—at prices you're happy to pay! The delicately balanced, polished aluminum handle...all-purpose knurled handle...the chuck with the *vise-like grip*...22 blades, carvers, routers and punches...smooth-cutting spoke shaves and planes constitute King Kut's Regal Treasure Chest. Each King Kut blade is sized and shaped to do its specific job, is made of the finest steel ...hardened throughout for money saving resharpening.

Try King Kut products. You'll agree King Kut meets every test in hobbycrafting—and wins!

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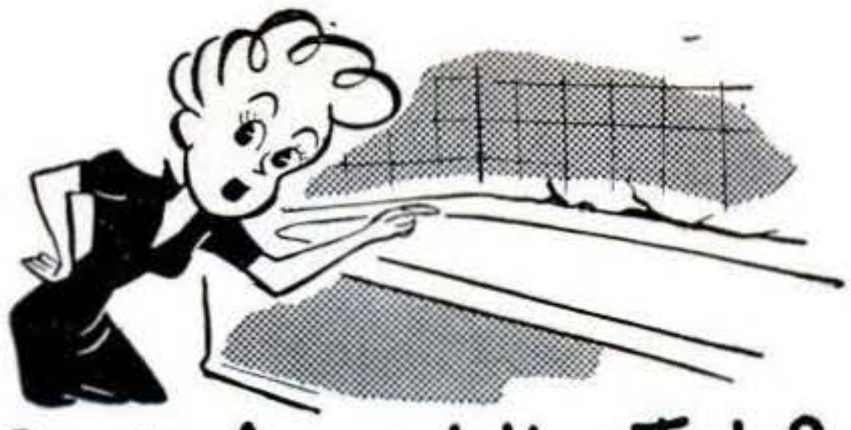

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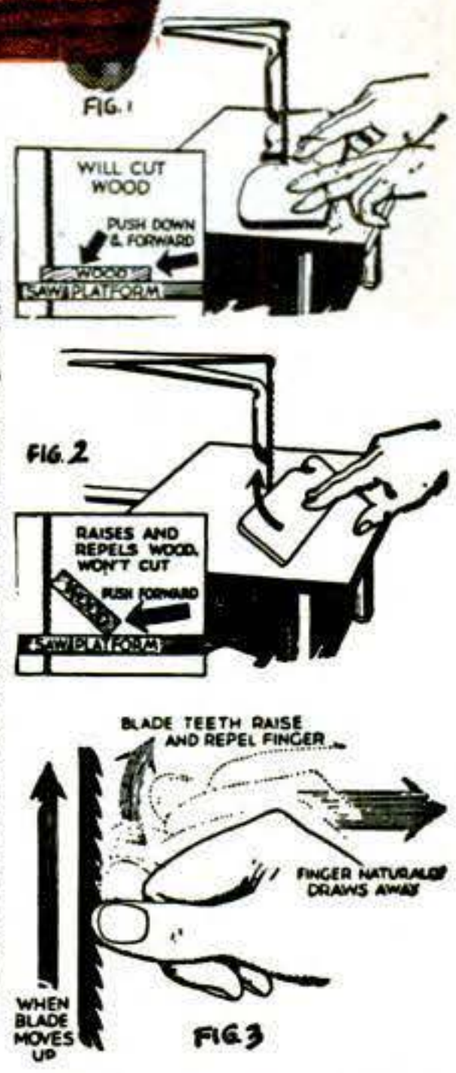

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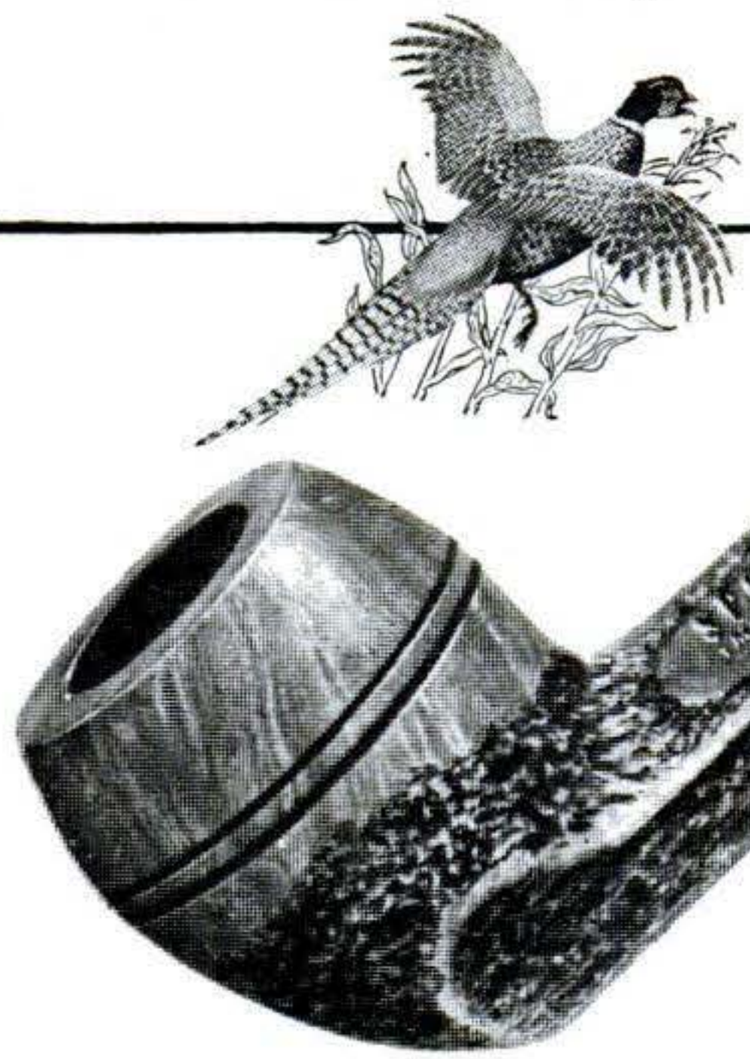

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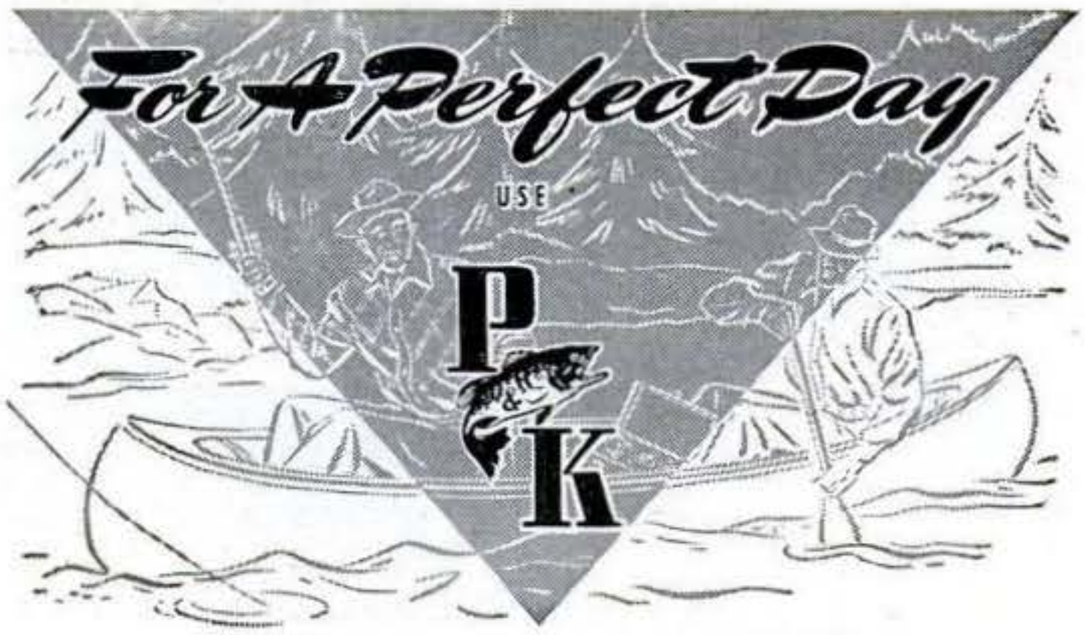

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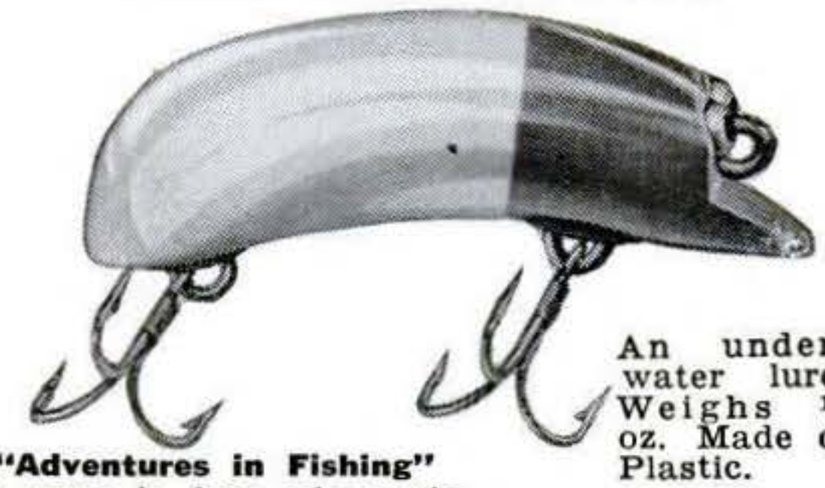

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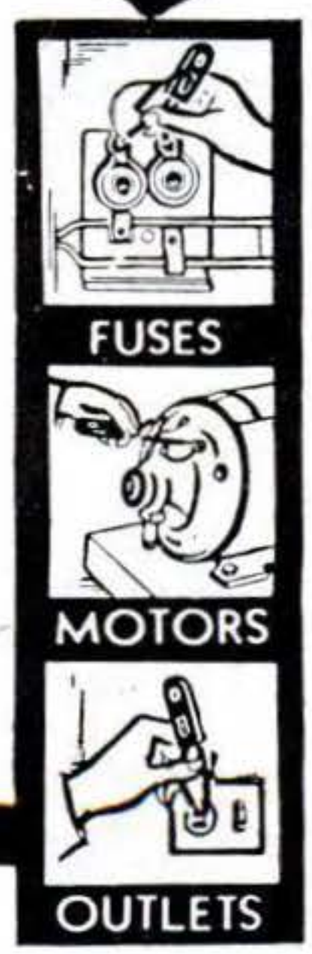

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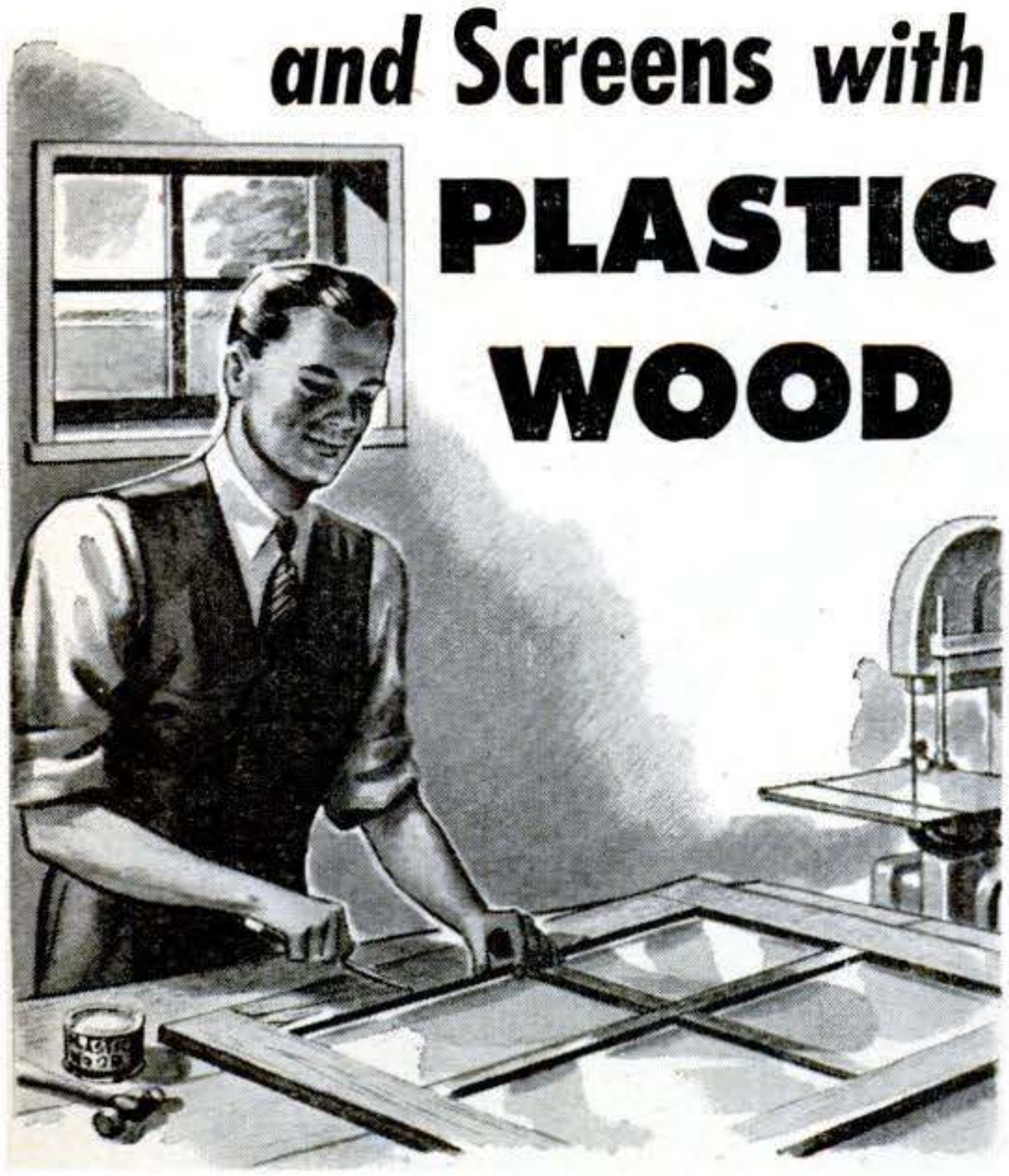

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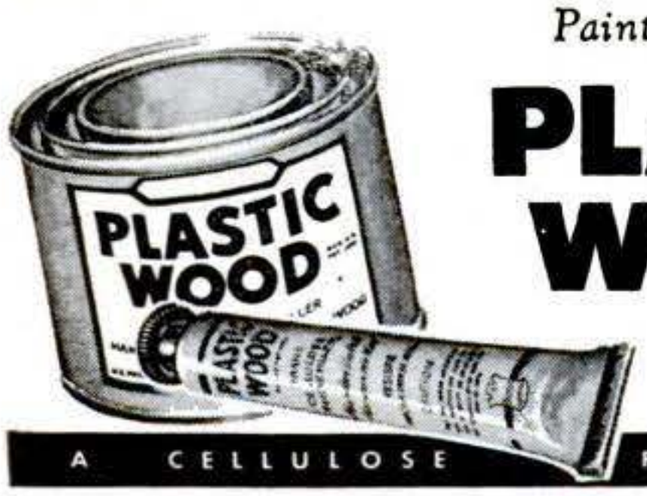

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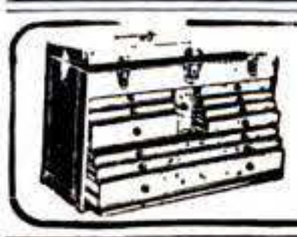

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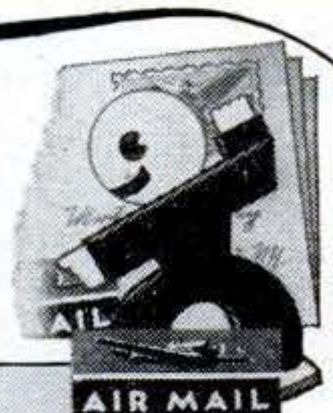

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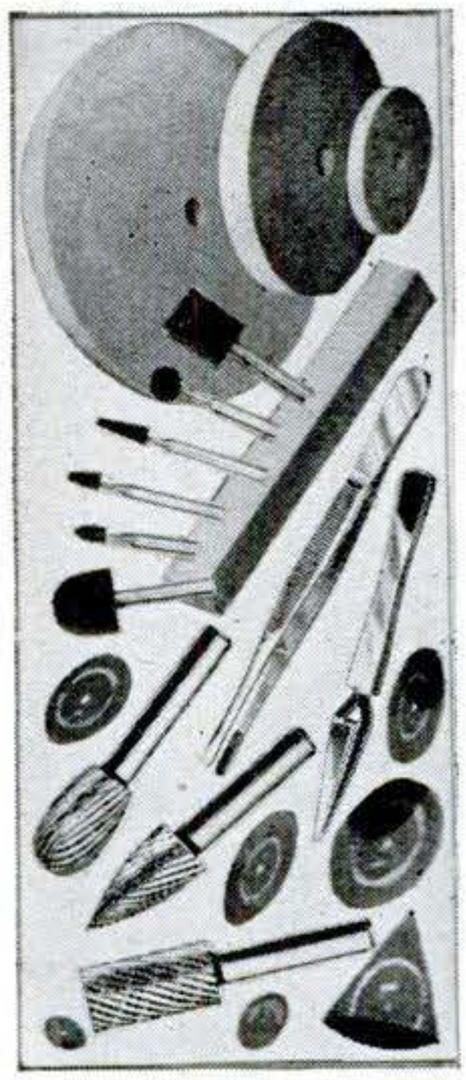

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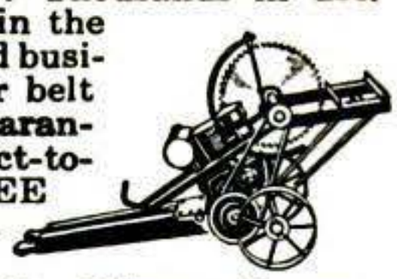

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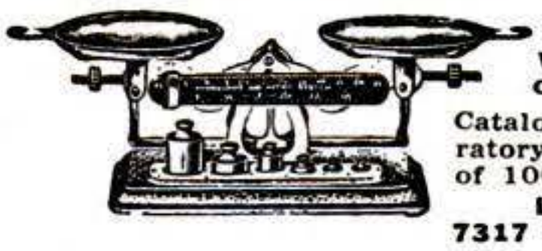

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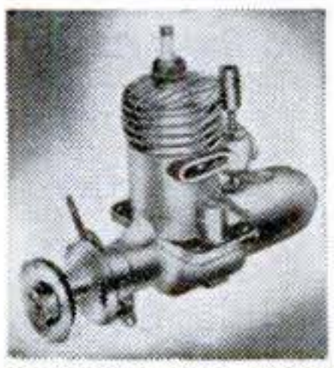

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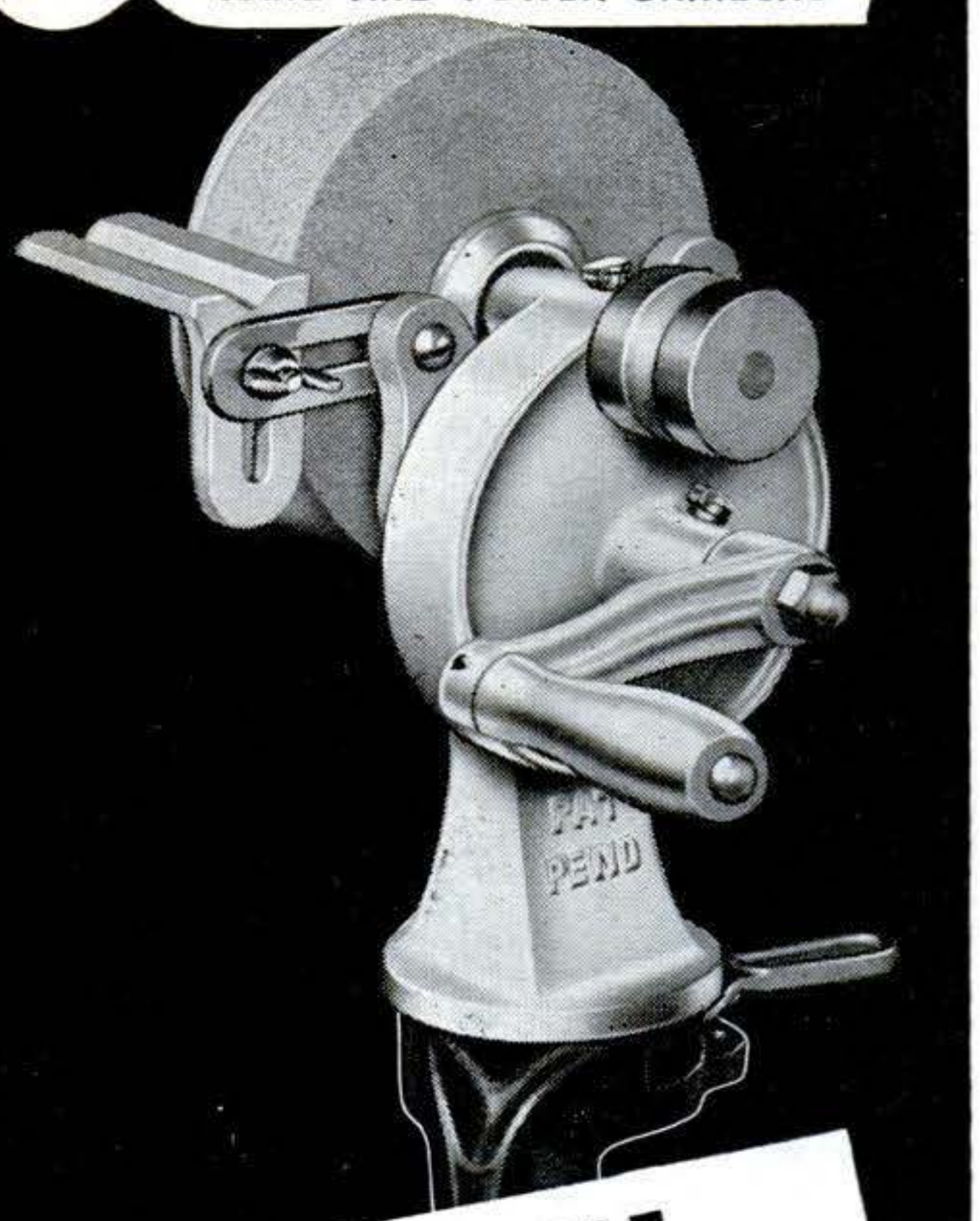

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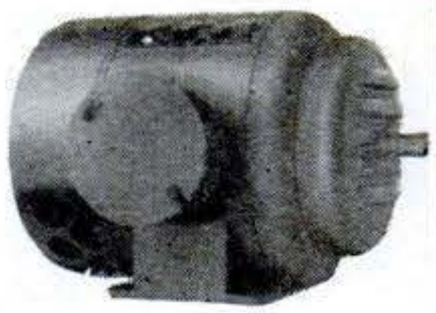

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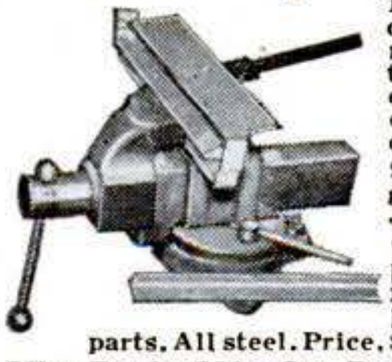

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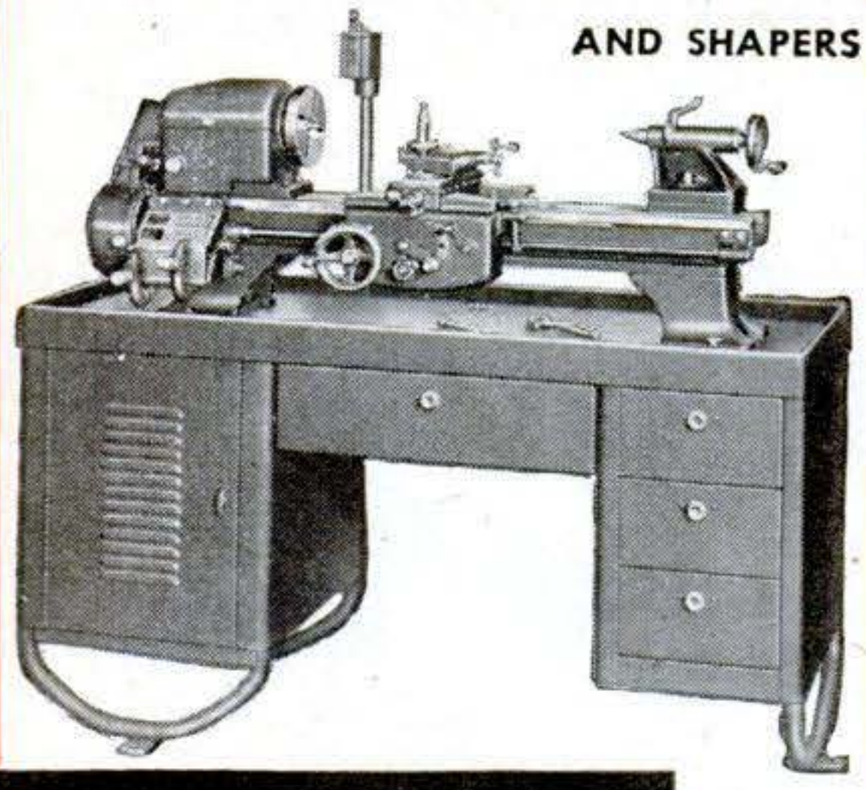

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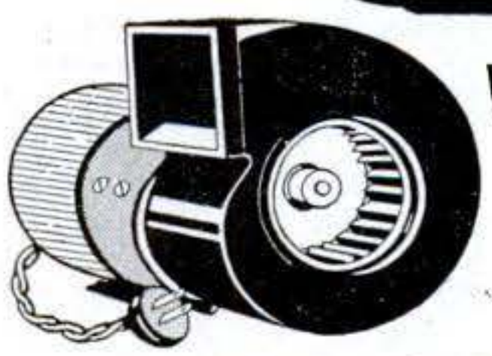

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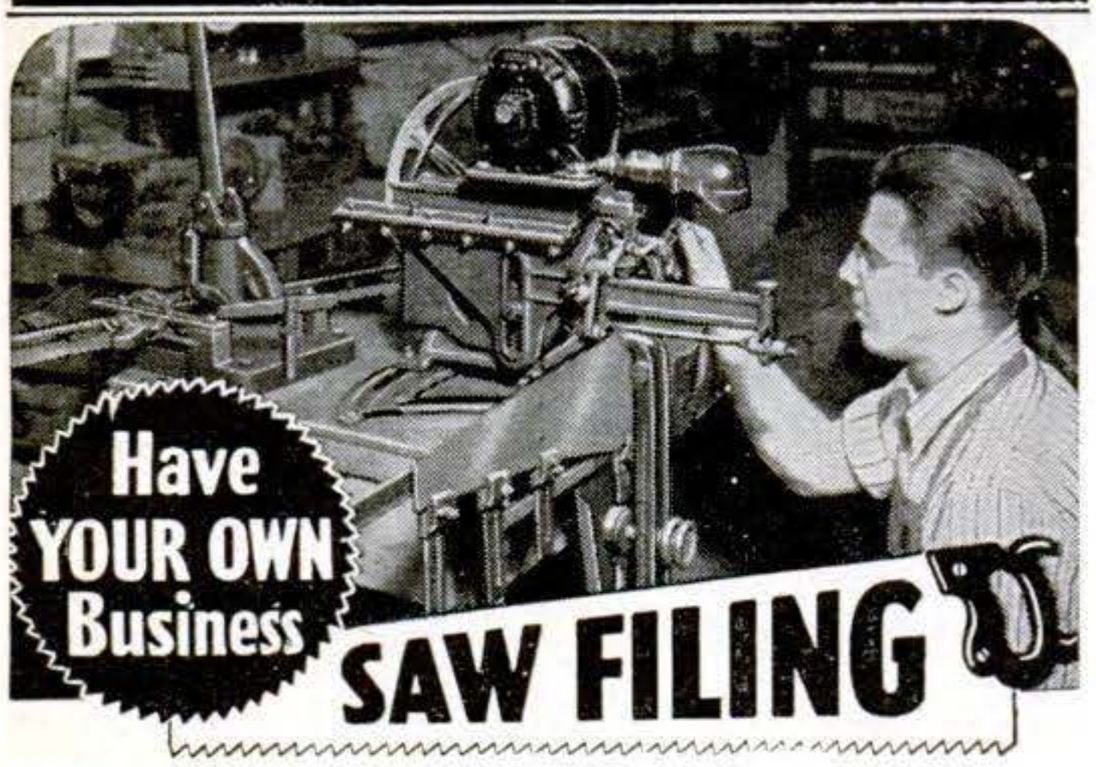

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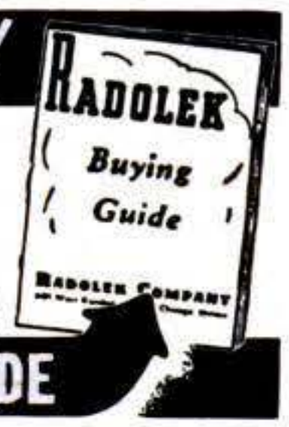

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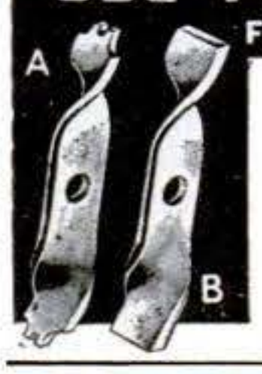

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Moto-Tool Kit No. 2 has 23 professional accessories and Model 2 Moto-Tool in wood case, $23.50. (Items purchased separately would cost about $30.00; you save $6.50) Moto-Tool No. 2 with one emery point $16.50.

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A TOOL THAT PACKS YEARS OF PLEASURE

Here's a tool to please a man's heart. A gleaming "powerhouse" that holds promise of endless creative hours. This "pocket-size machine shop" is a war veteran . . . used by all branches of the armed forces in far flung repair bases . . . and it helped set production records at General Electric, Westinghouse, Remington Arms, Ford and other plants. Hobby enthusiast or expert craftsman . . . first choice is model 2 Moto-Tool kit, with its handsome, felt-lined, highly finished wood case . . . with rows of tools begging to be put to work. The usefulness of Moto-Tool for precision work is increased by two versatile attachments now available at slight additional cost (see below).

Look for These Features

Housing has "pencil-type" fingergrip; instant-action, wrenchless chuck; oil-less (sealed) bearings; patented automatic chuck-lock pin; oversize armature shaft, hardened, ground and polished; 110 volt universal type motor; easily replaced commutator brushes; sliding, snap-type switch; handy hanger hook; cord protector; sturdy, shock-proof bakelite housing; dust-filtered, air-cooling system; weighs only 13 oz; shaped to fit the hand; dynamically balanced for vibrationless operation.

MONEY BACK GUARANTEE

Buy Moto-Tool and Accessories from your dealer; or order direct from factory on 10 day trial, money back guarantee.

DREMEL MFG. CO.
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Free Both Hands With Moto-Tool Attachments

A. Moto-Tool Universal Stand holds Moto-Tool at any angle. **$4.50**

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C. Shaping Table, inverted, for routing—**$2.50**

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- ☐ Scoring
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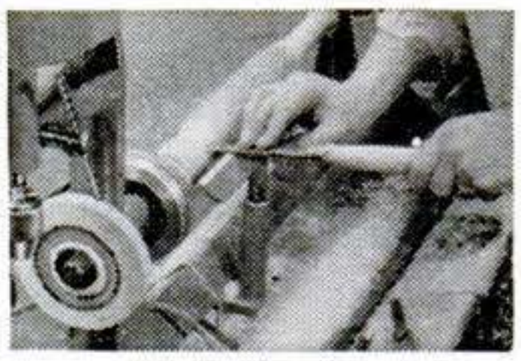

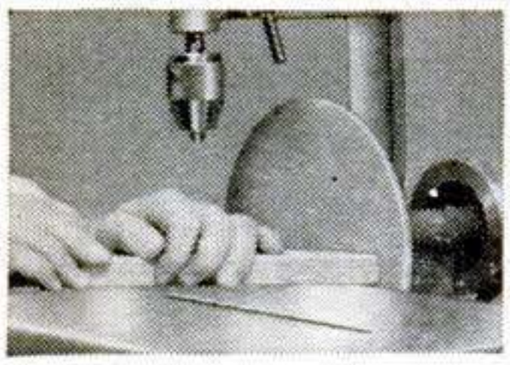

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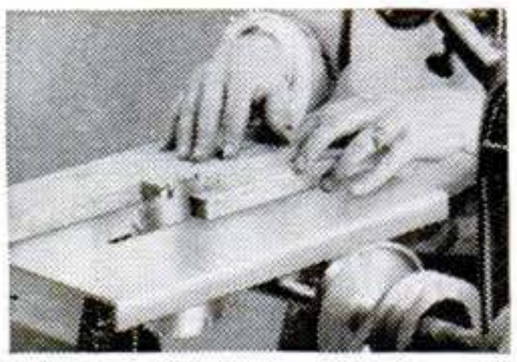

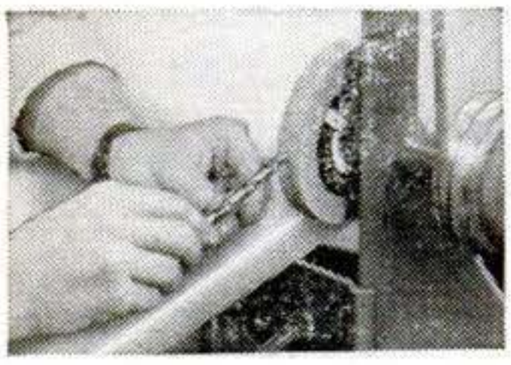

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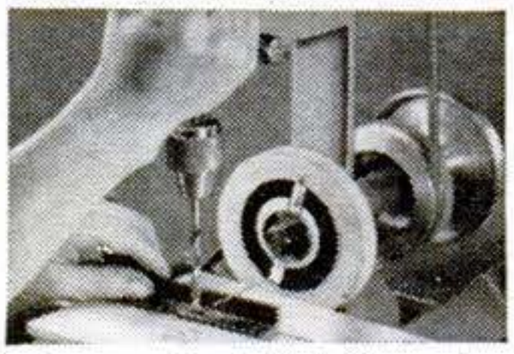

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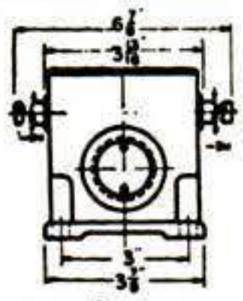

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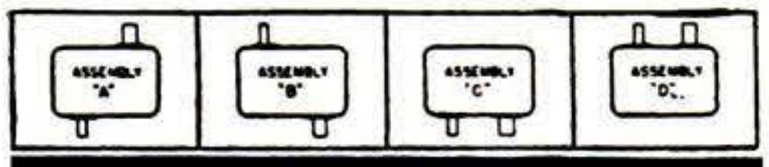

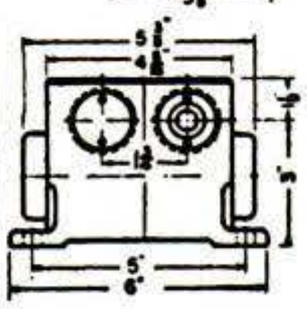

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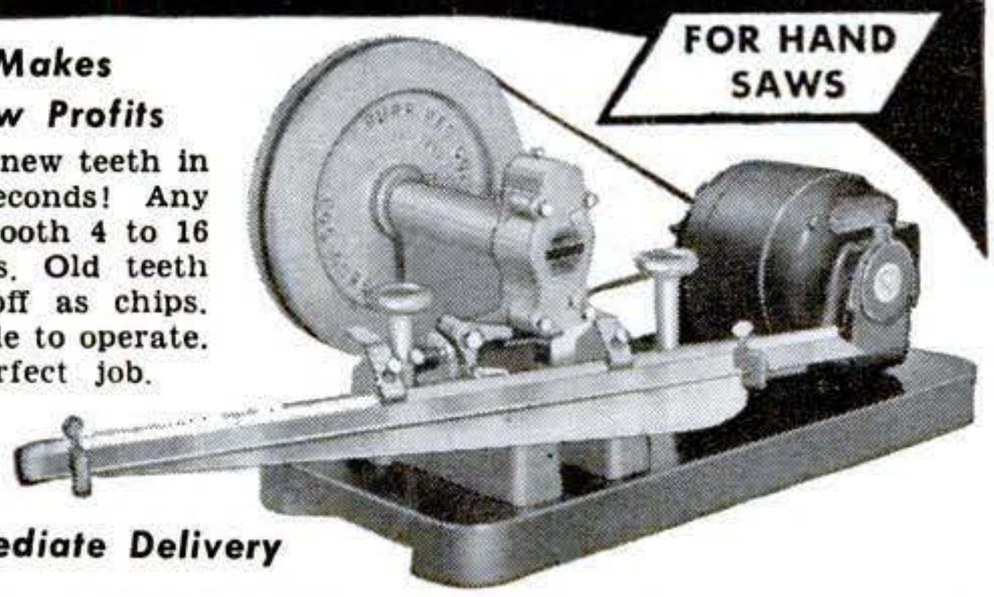

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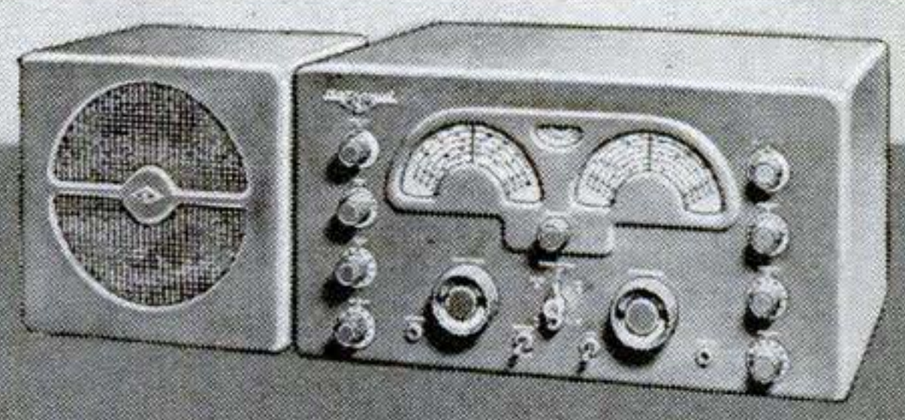

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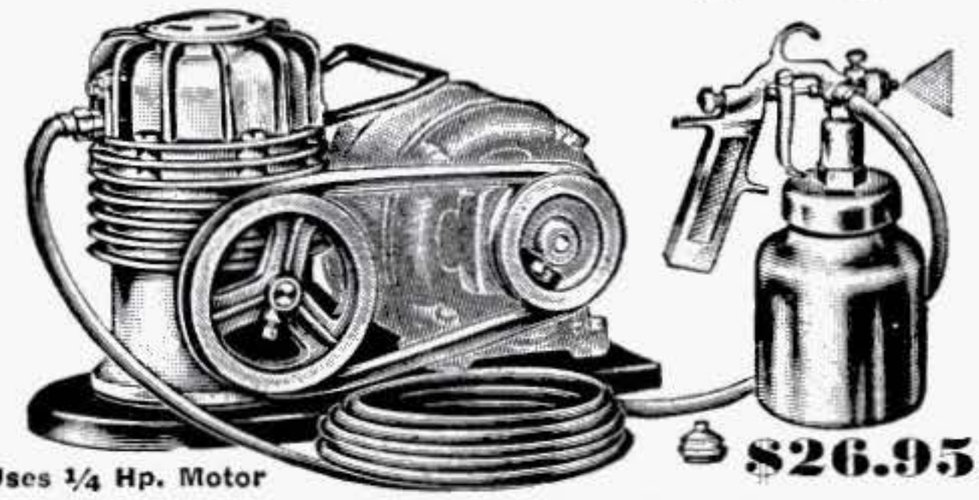

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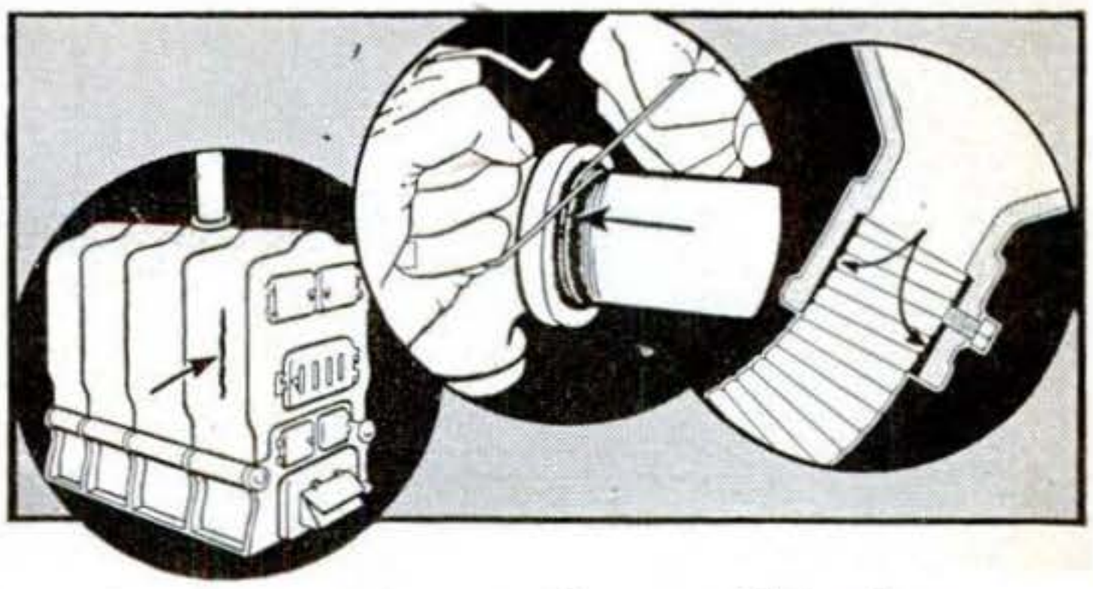

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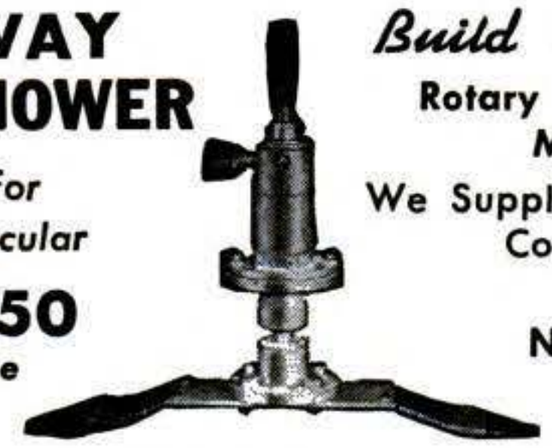

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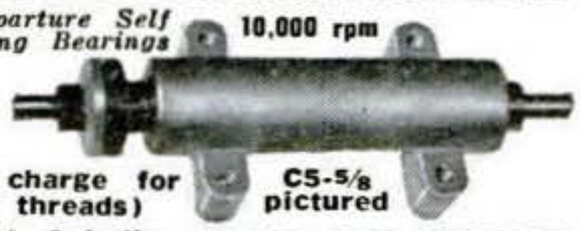

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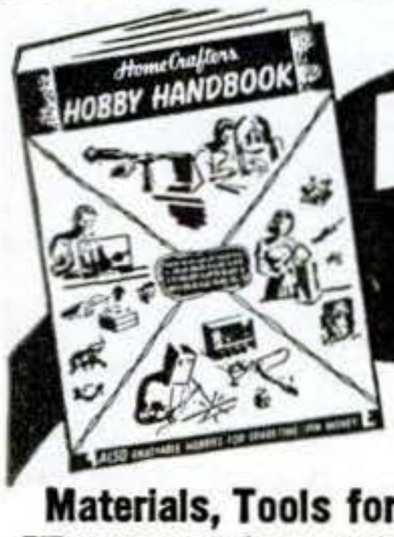

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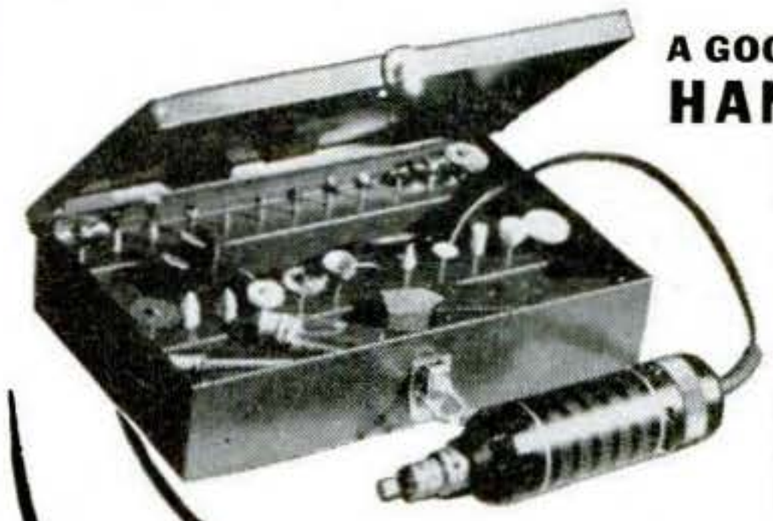

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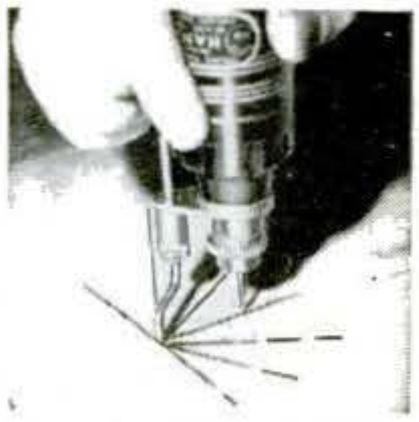

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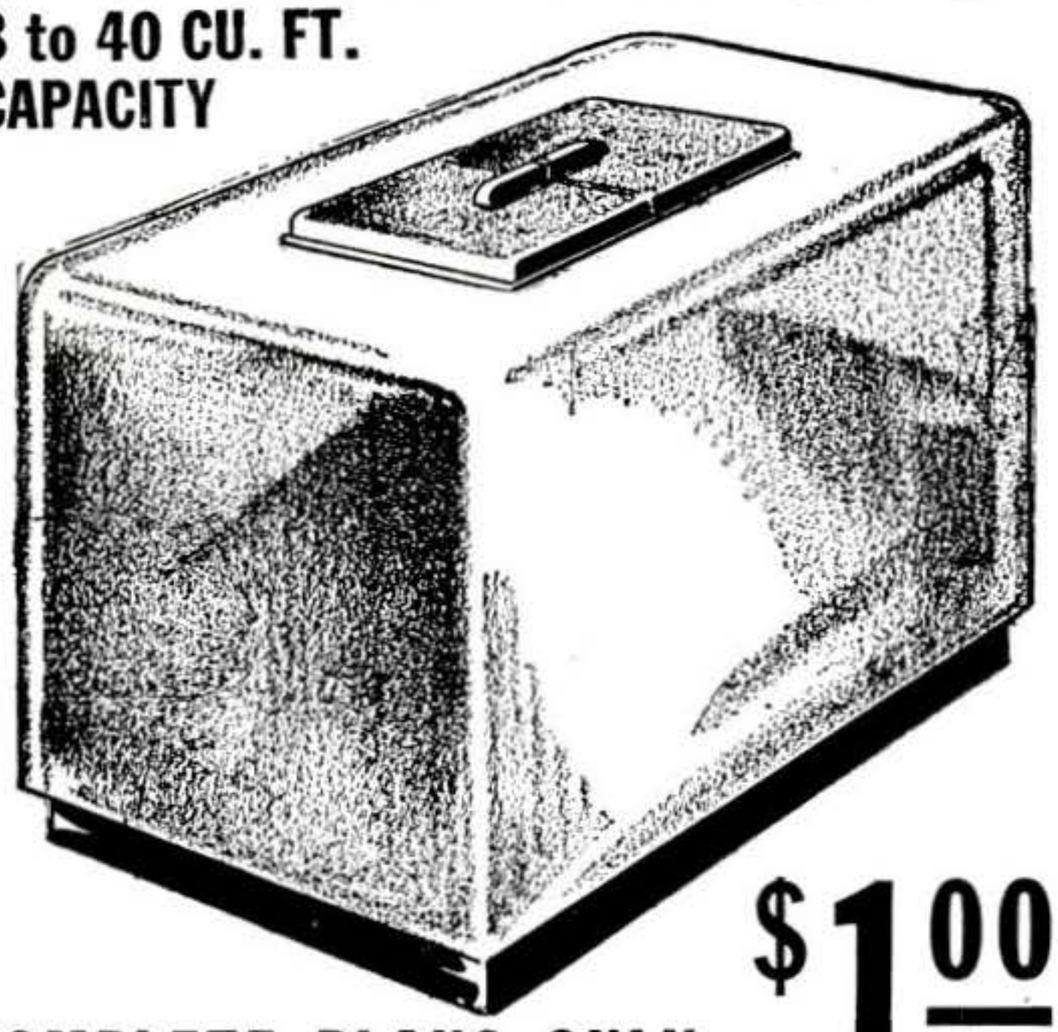

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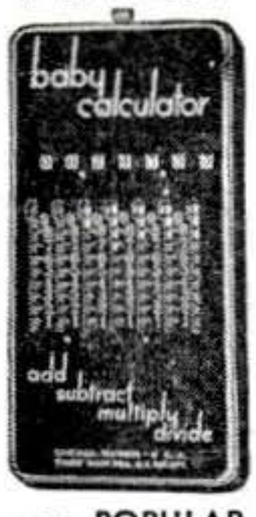

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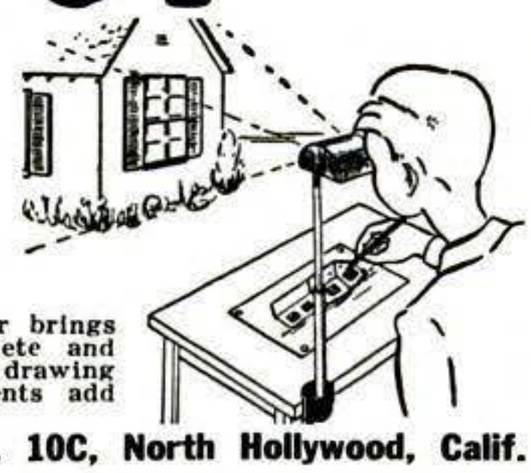

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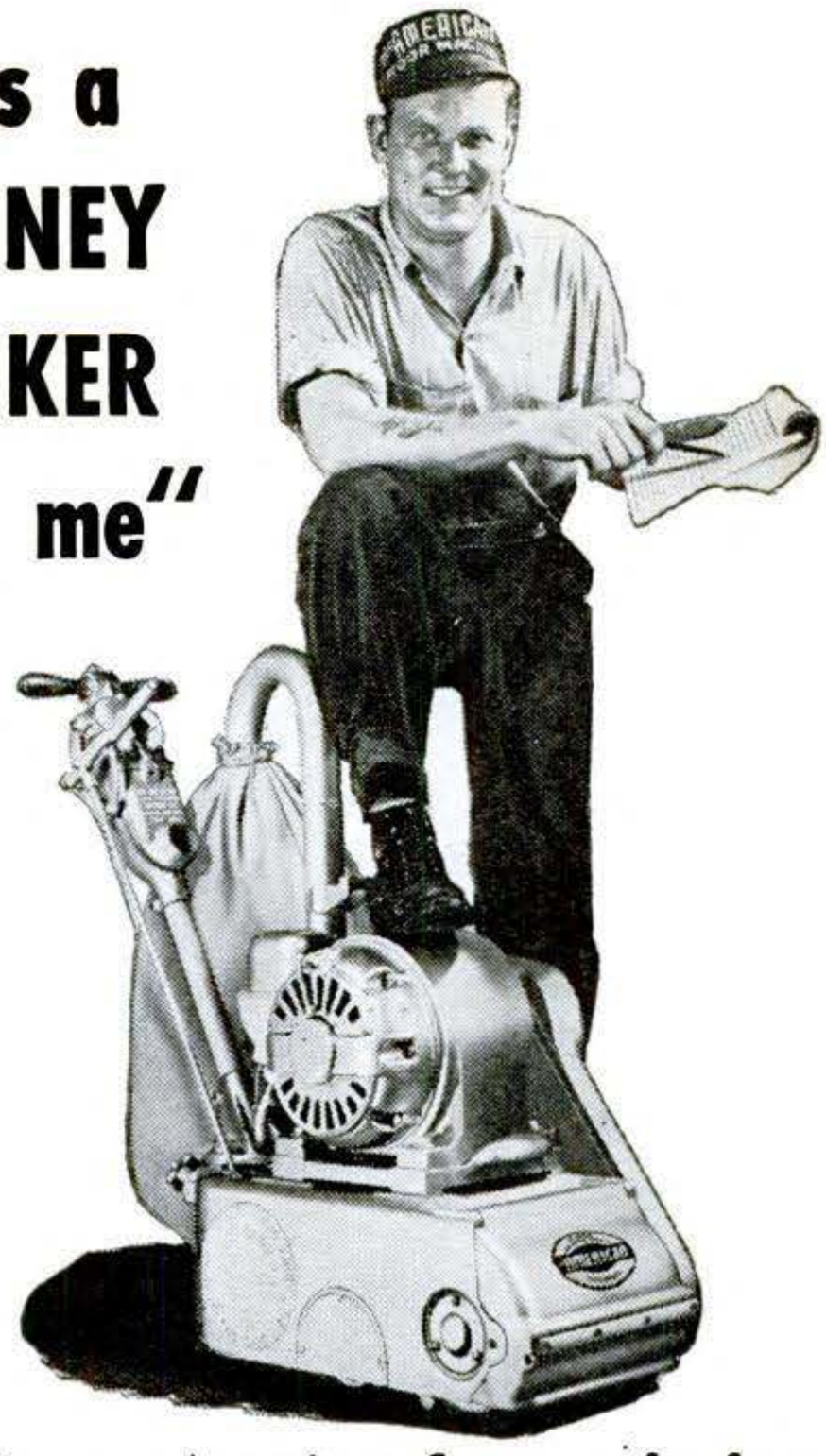

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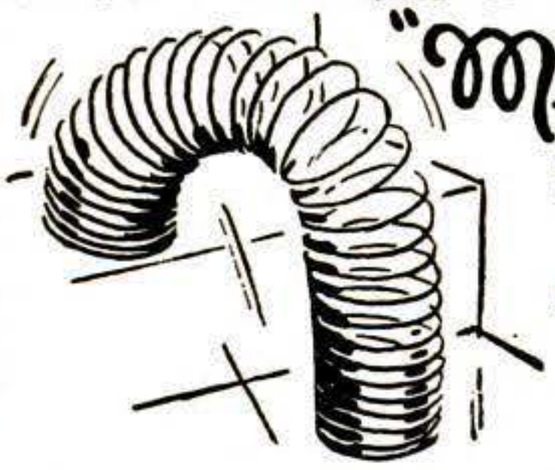

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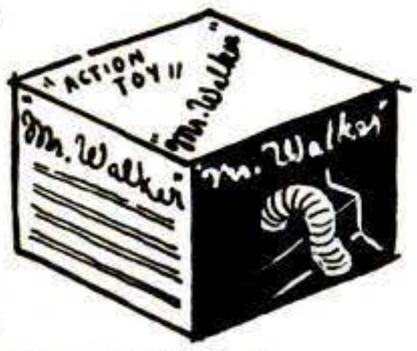

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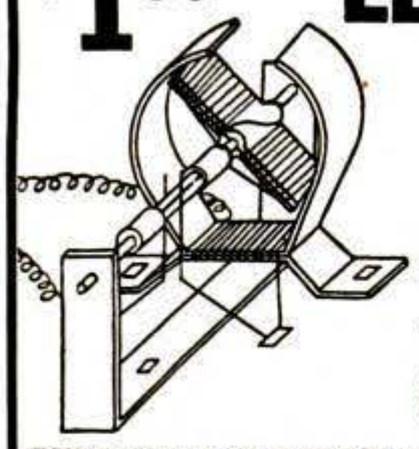

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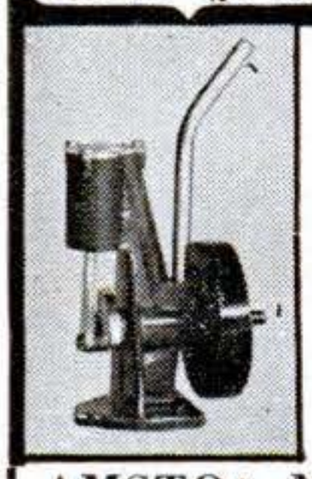

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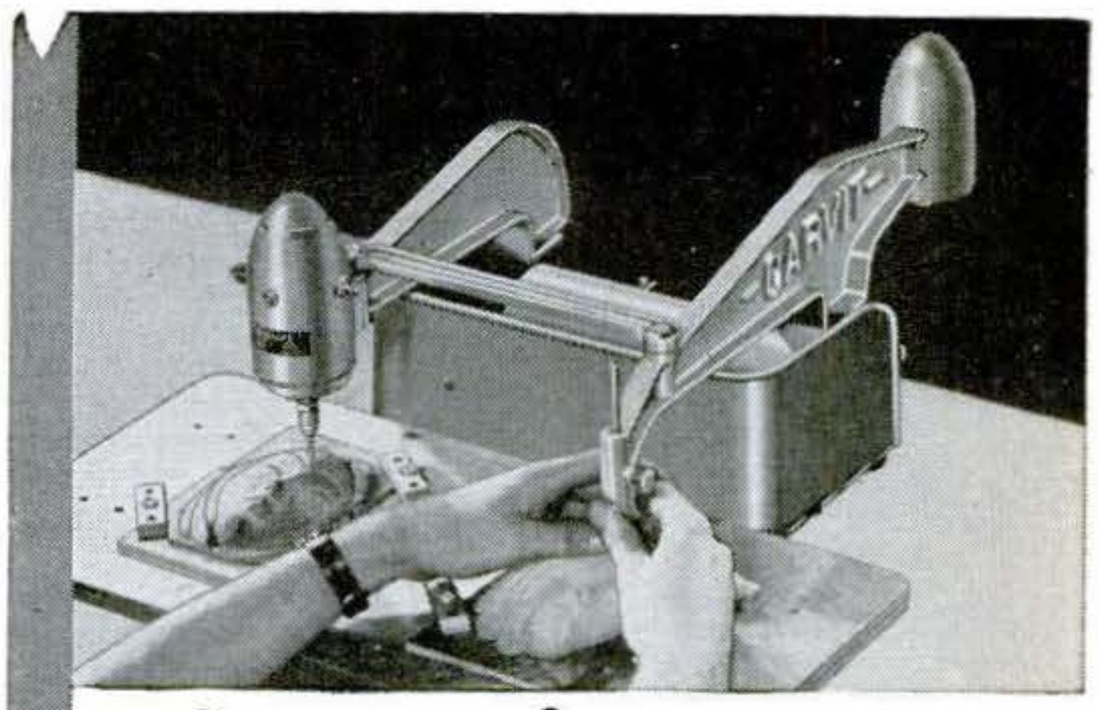

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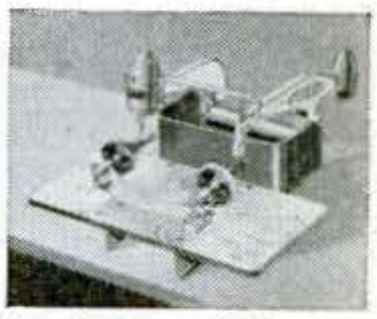

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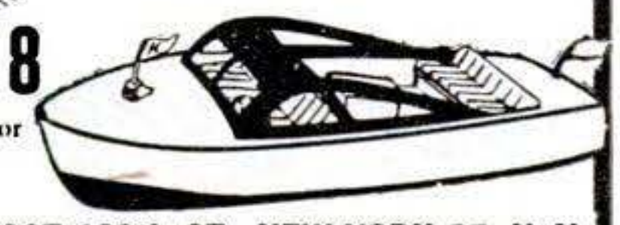

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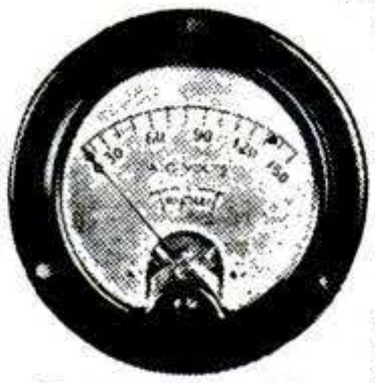

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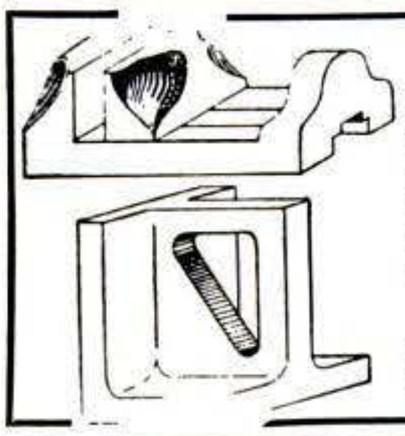

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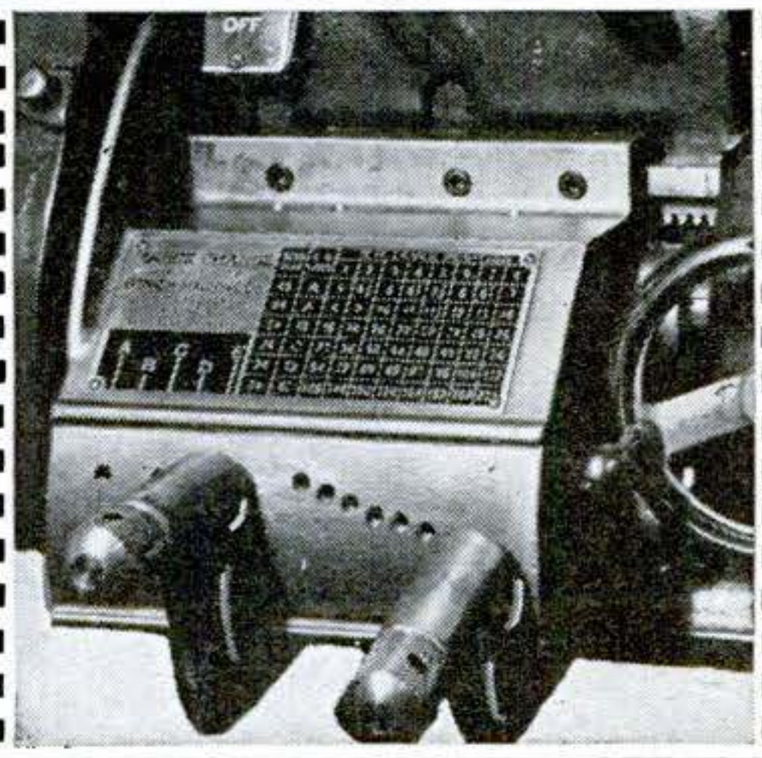

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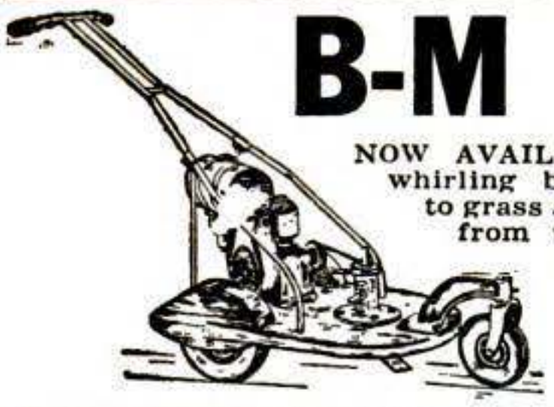

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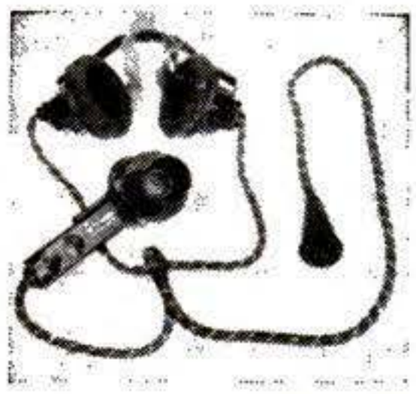

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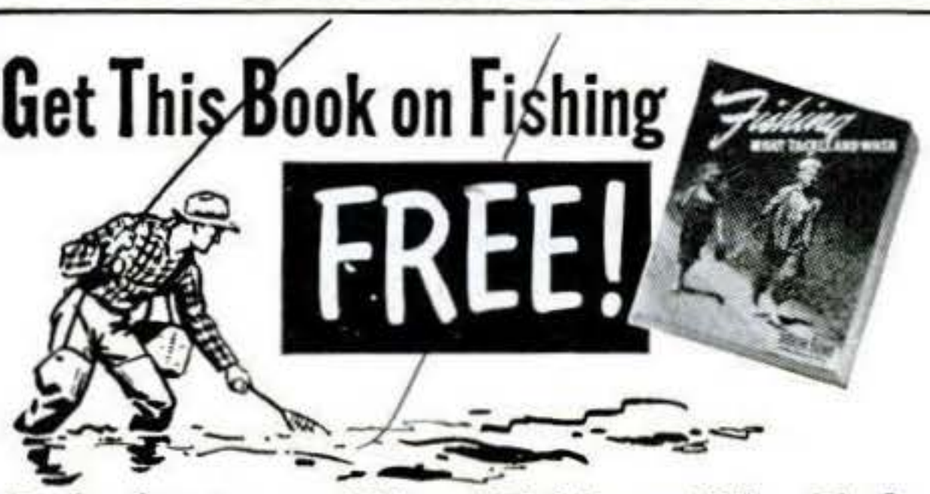

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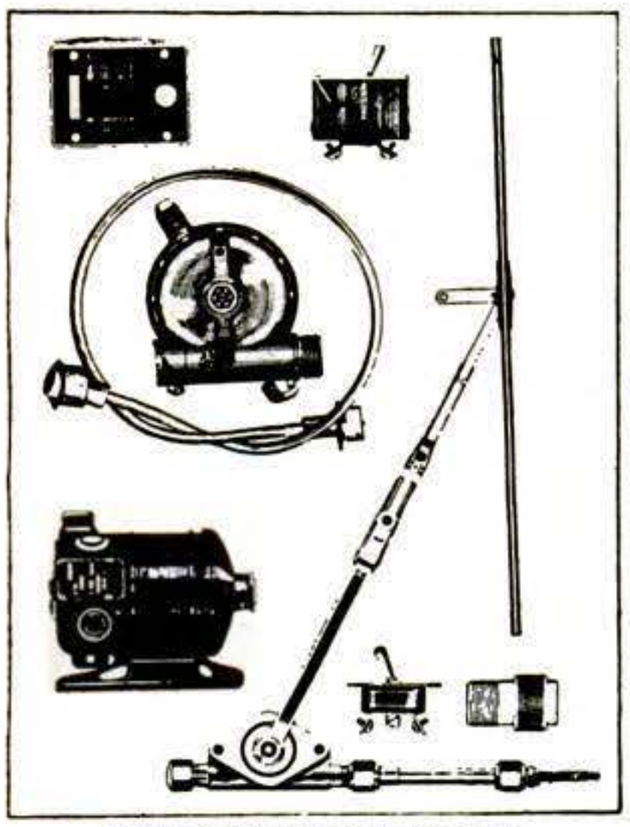

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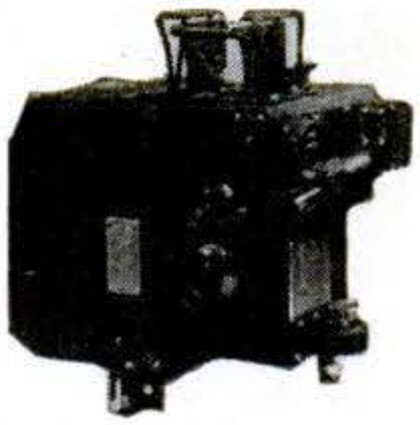

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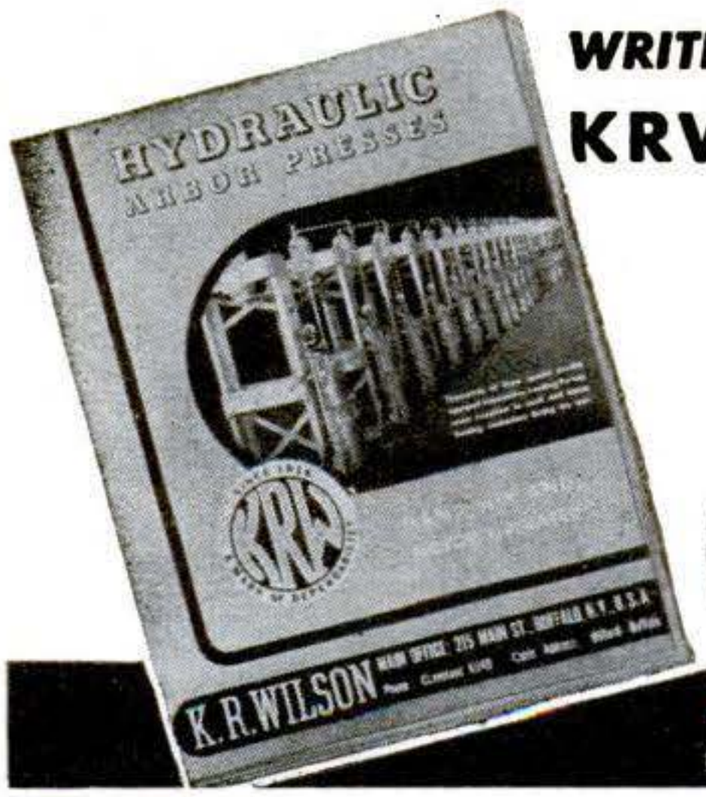

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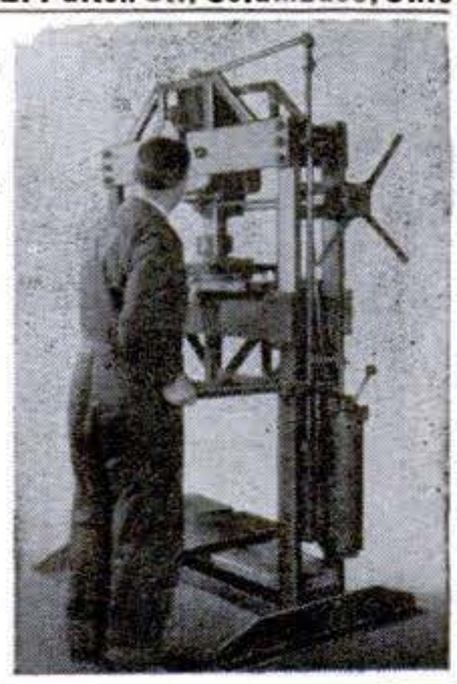

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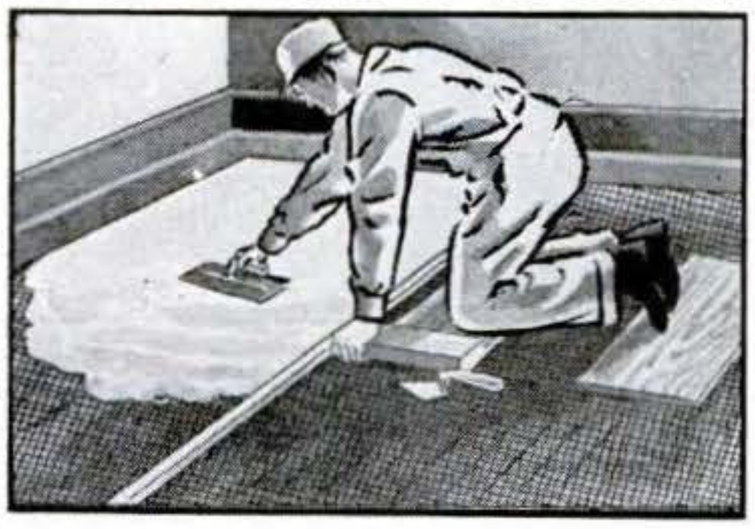

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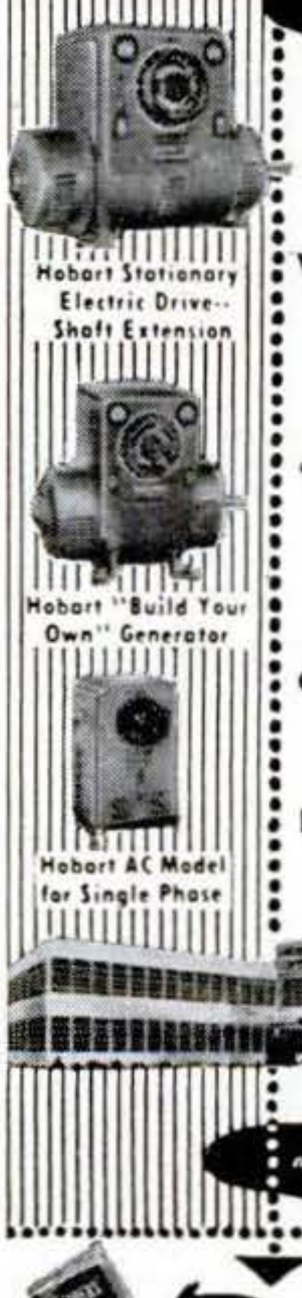

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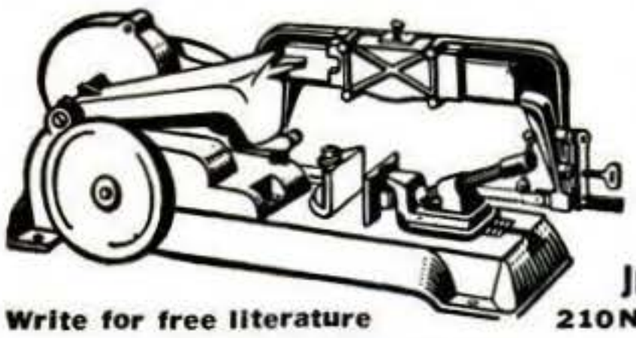

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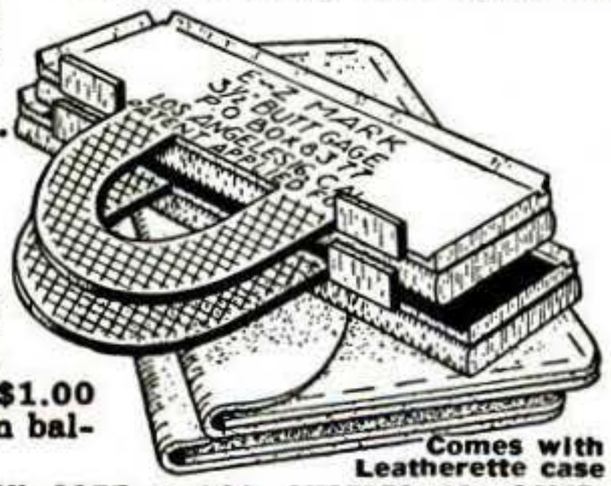

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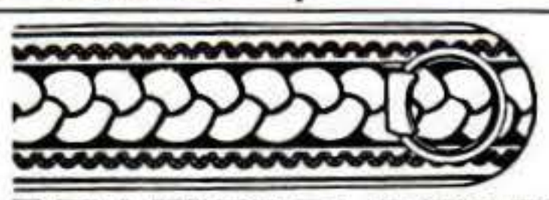

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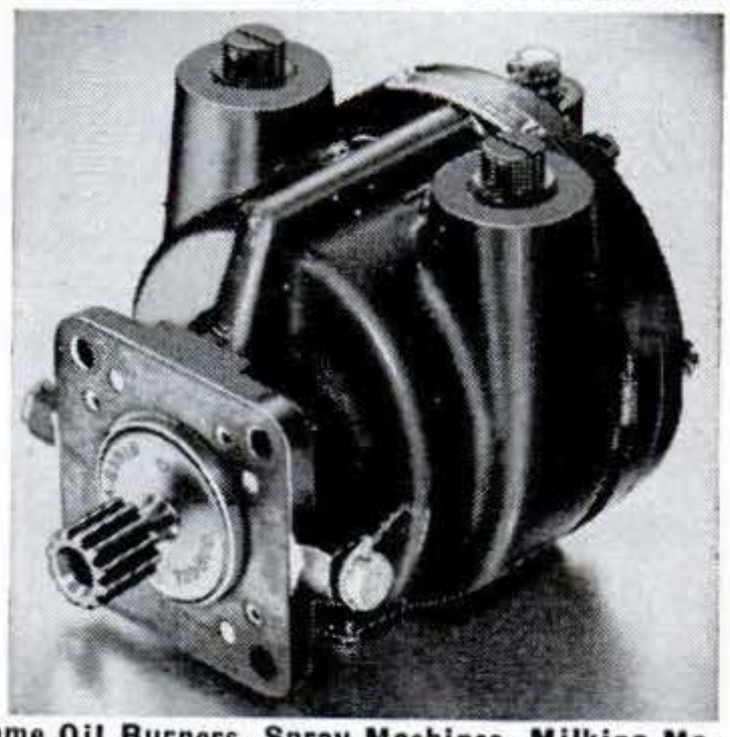

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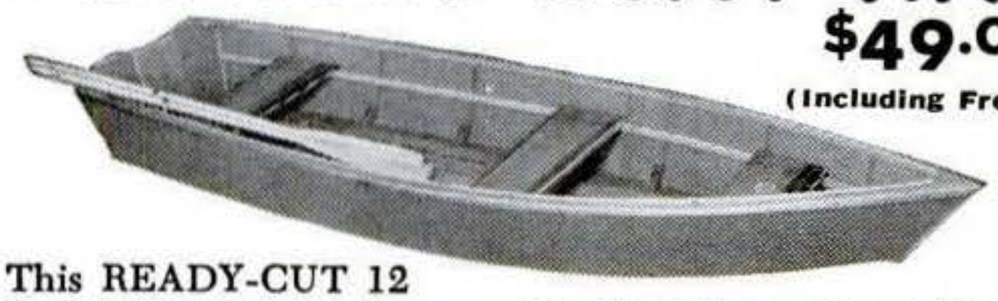

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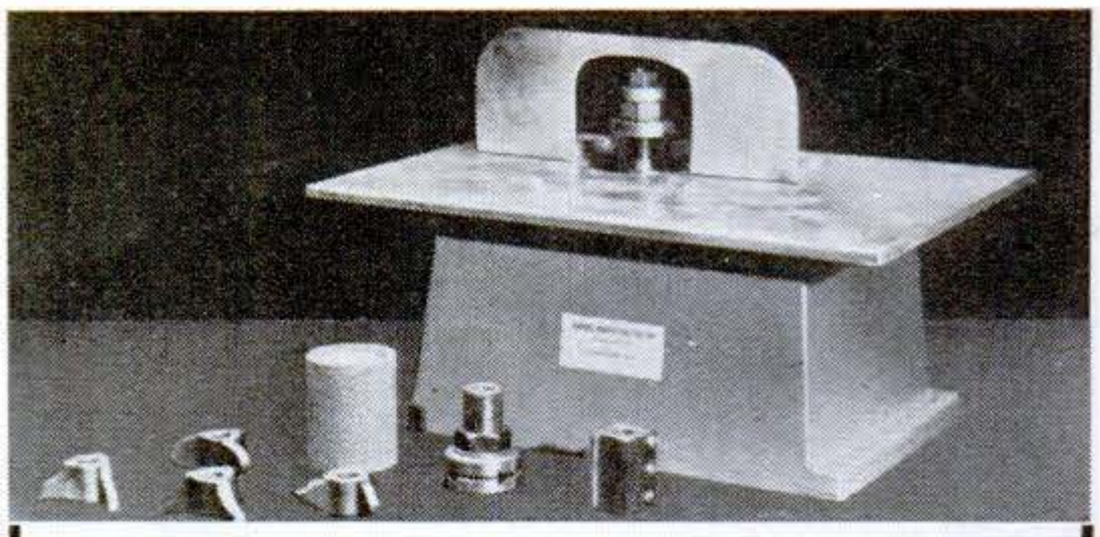

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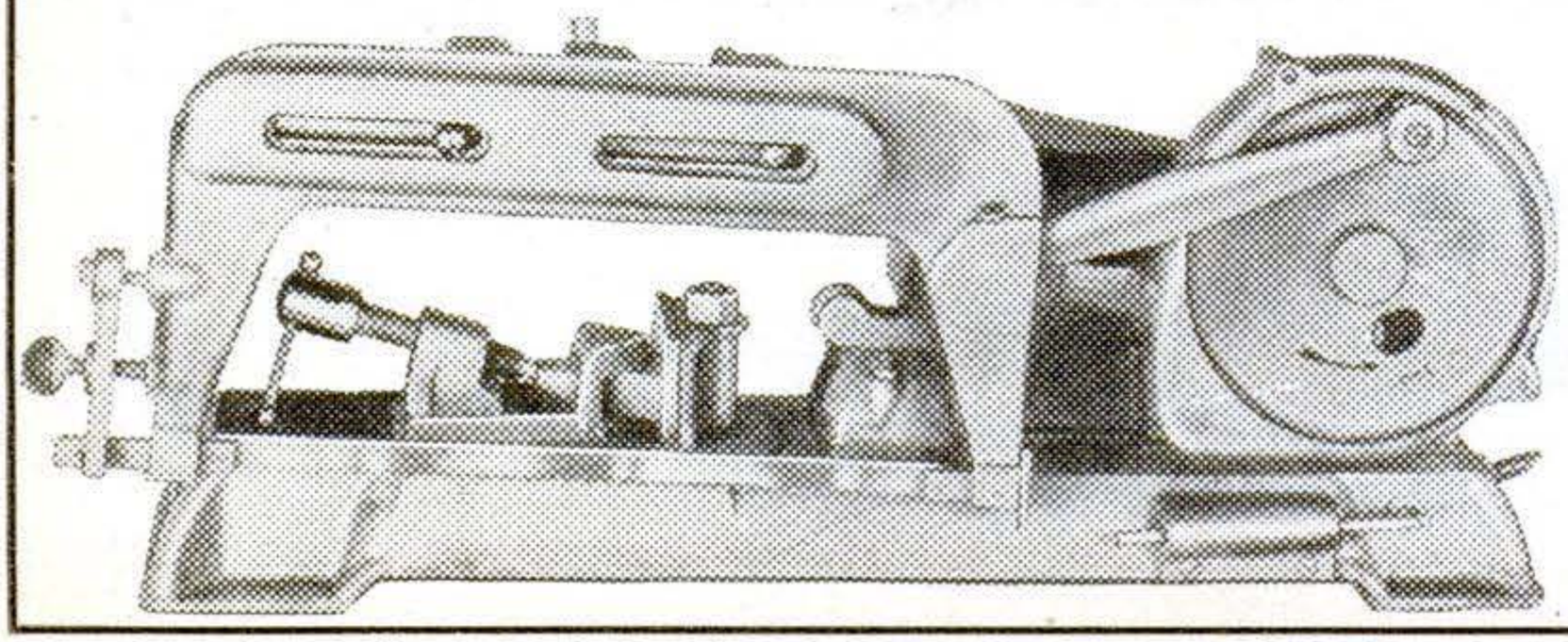

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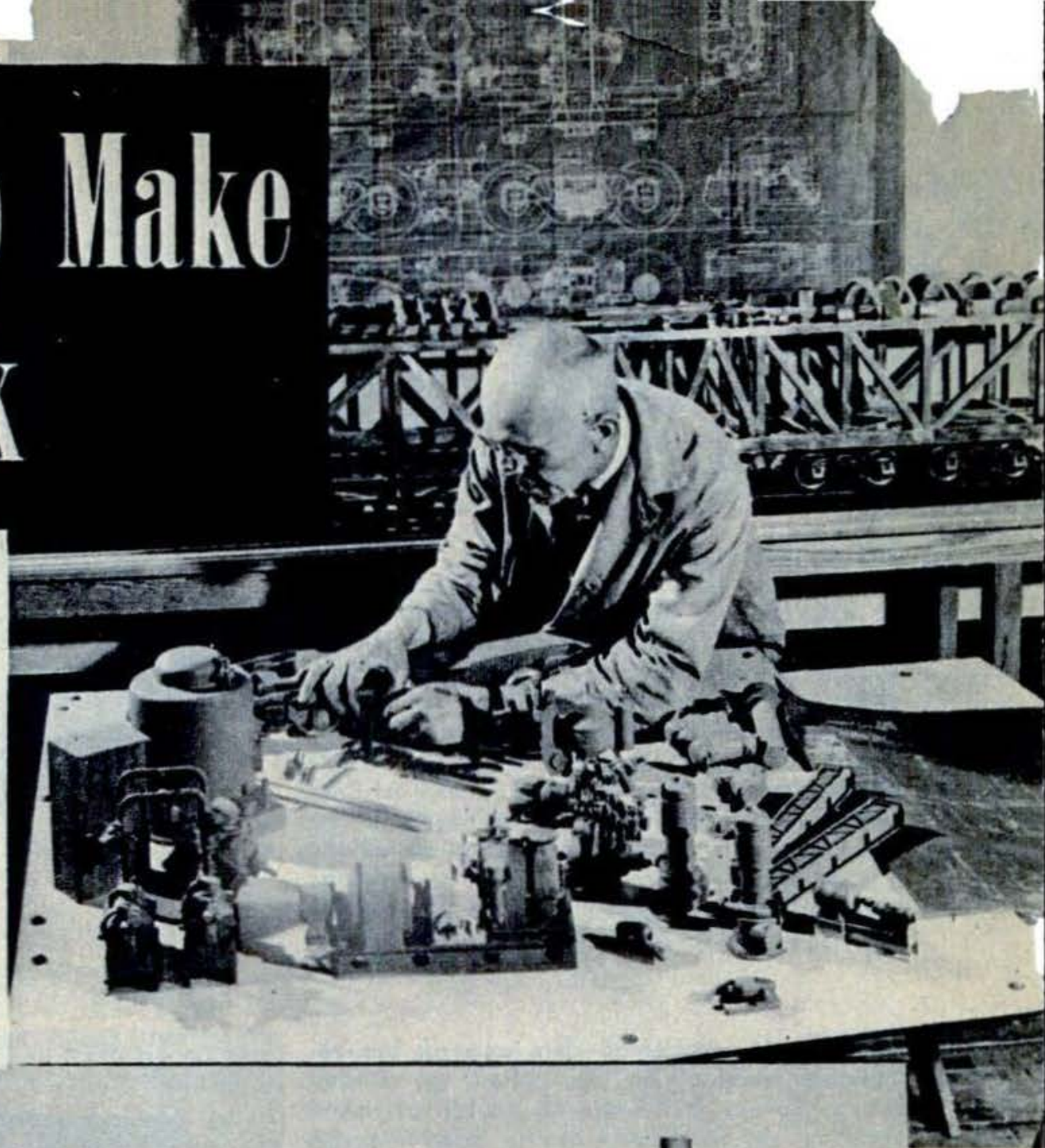
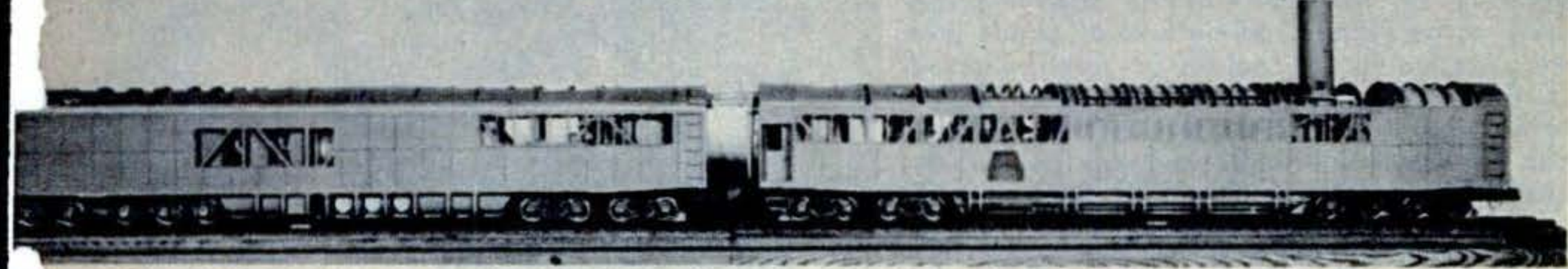
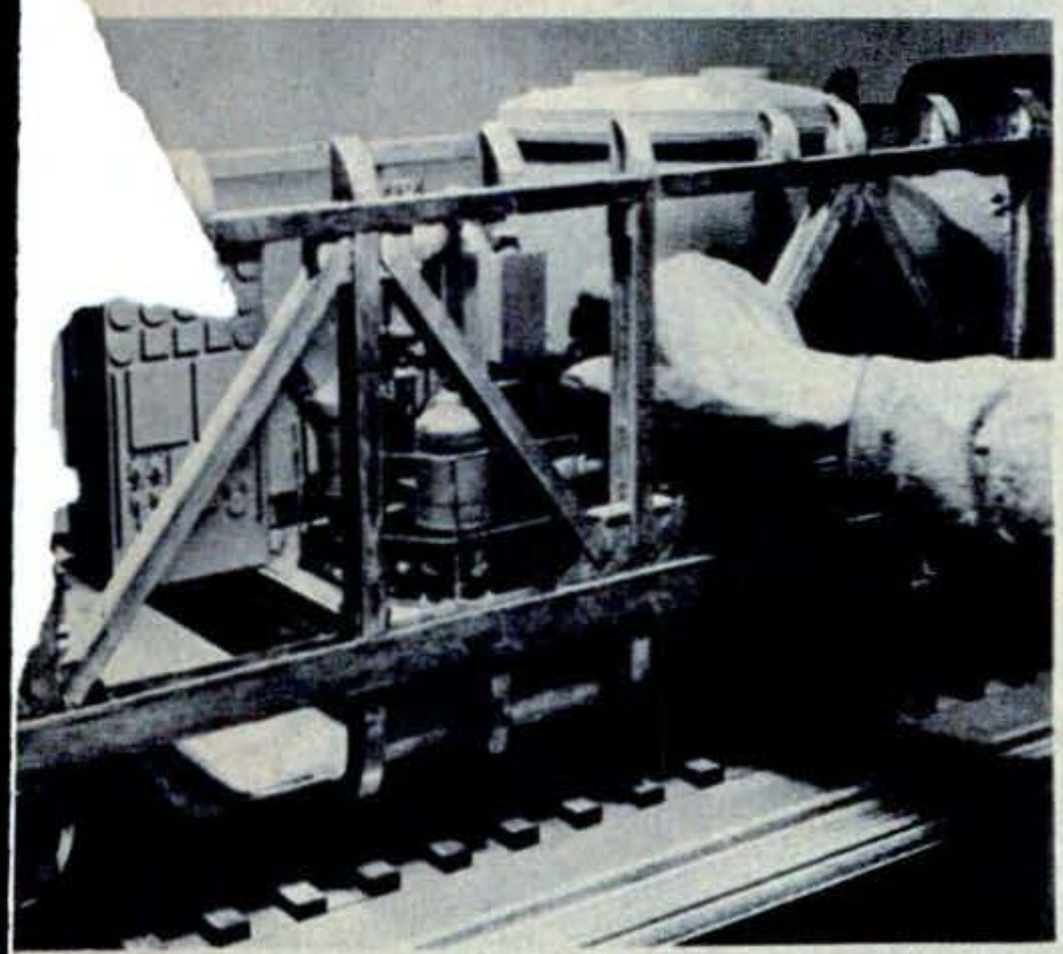


Modelmaker Chesebro working on his most complicated project, a ale model of a 10,000-kw. power ant mounted on two railroad ars. Scale was 1/2 inch to the ot. Below is the model, which hesebro and an assistant worked n for 10 months. Car on left car- es boilers to power huge turbine enerators in car on right.





Setting a tiny valve in place on a turbine generator of the mobile power plant model. Built to supply emergency power for bombed-out cities, full-size mobile plant was never needed for original job but powered remote indus'rial installations.

HOWARD E. CHESEBRO'S job is a workshopper's dream: He makes exact scale models of everything from airports to appliance stores—and is paid for his fun. For Chesebro is General Electric's official modelmaker—and GE engineers have found that it saves time and money to have him turn their blueprints into three dimensions before building the real thing.

Chesebro's products range in scale from full size to 1/100 inch to the foot. His materials are equally varied: white pine for carvings, maple for wood turnings, brass and galvanized iron for structural members, white metal and aluminum for cast pieces. His outfit includes metal and wood lathes, sanders, circular saws, jointer planers, casting flasks—plus woodworkers' and machinists' finishing tools.

You'll find Chesebro any evening after work in a barn on his farm at Rotterdam, N. Y. But don't look for cows. The barn houses his home workshop. Chesebro spends his spare time making models.

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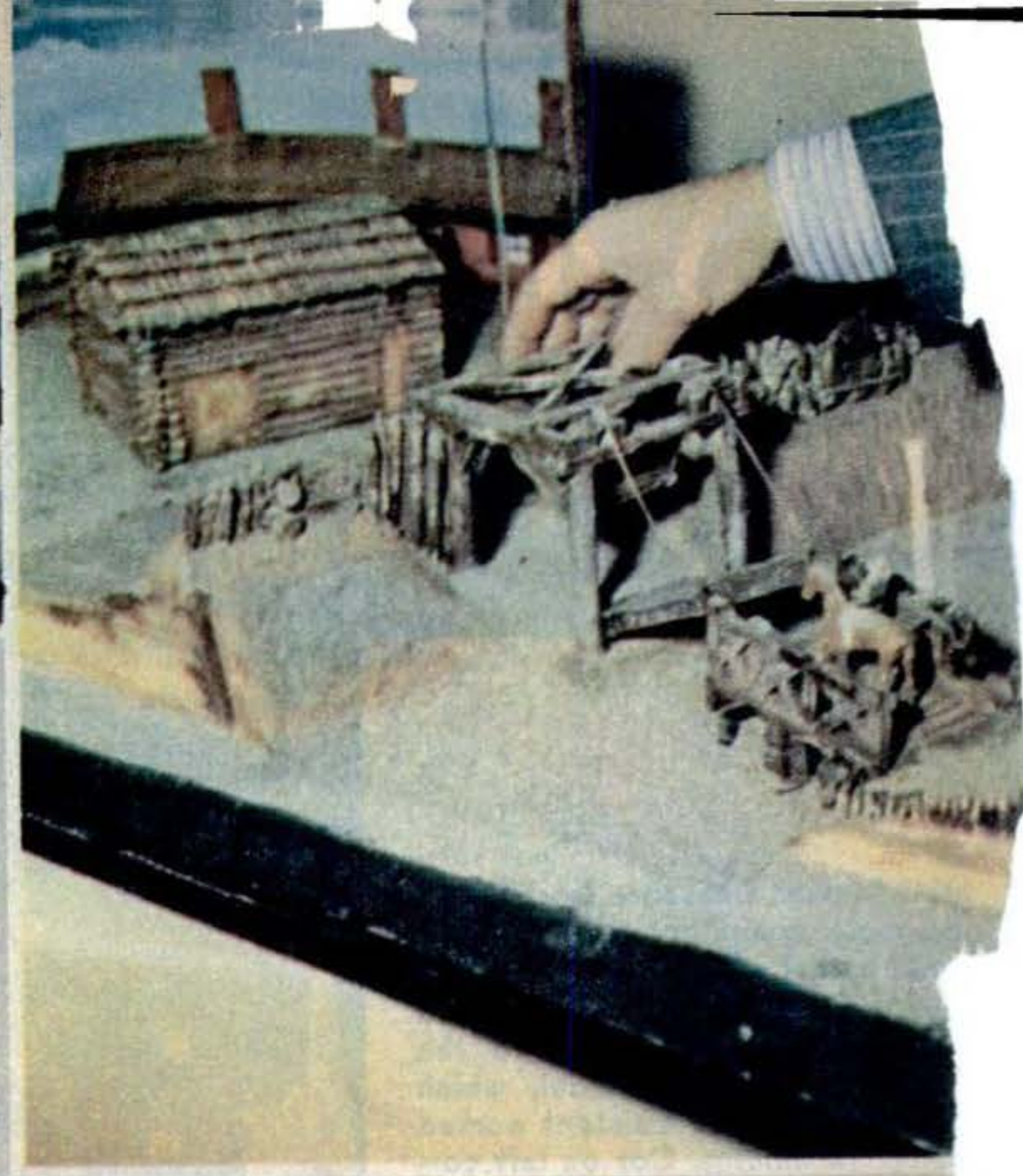
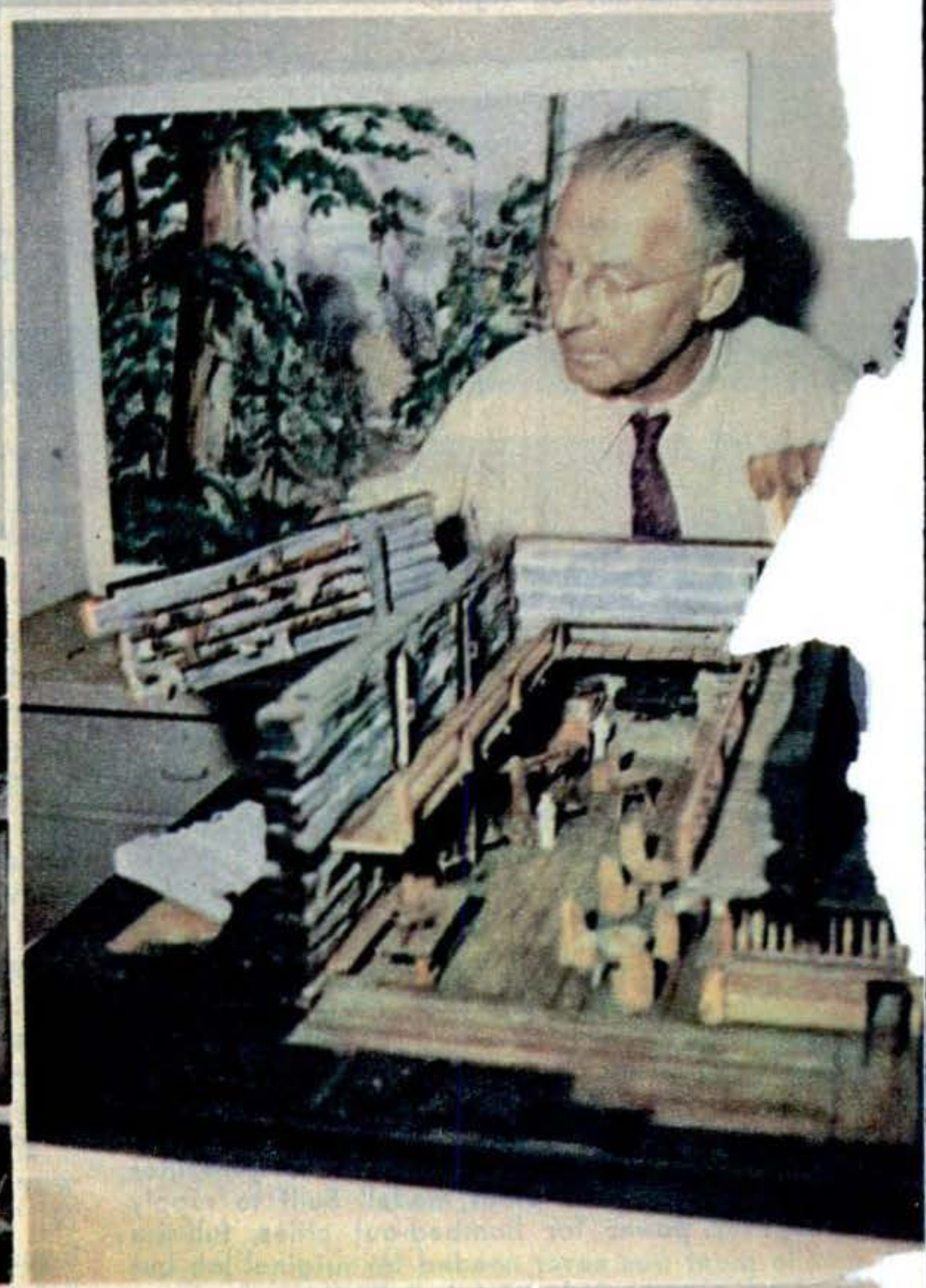
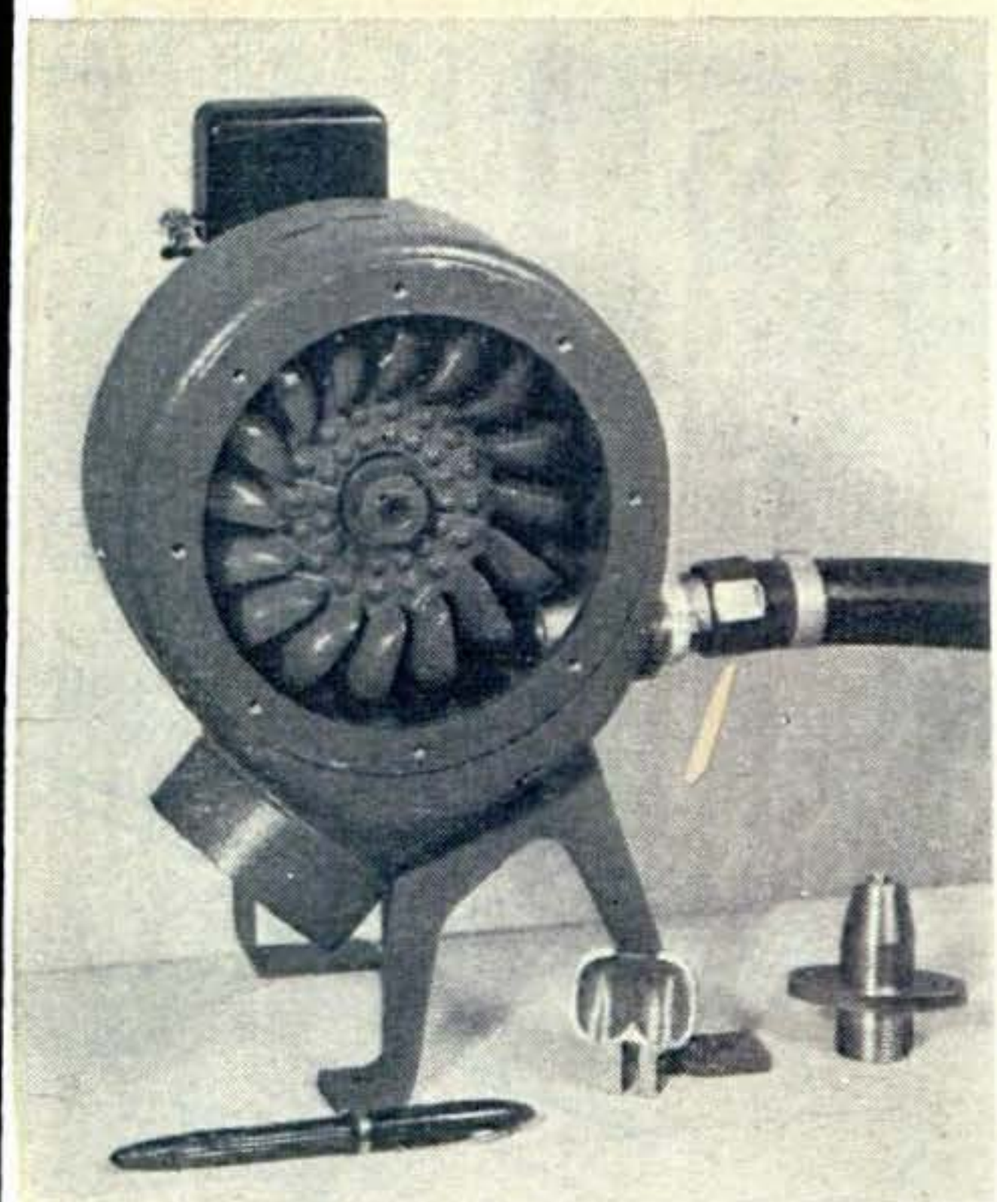


One of the scenes that cost less and came off more smoothly because it was first worked out with the aid of a miniature set is shown above. It pictures Seneca chief Guyasuta holding a white flag in his demand for surrender. The drawbridge in right background was built from the model in photo at right. Model is a reproduction of the counter-balanced drawbridge that protected Fort Pitt, constructed according to drafts found in the British Museum. Bridge's weight equals weight of a swing-down inner door. When door swings open, bridge is raised. A watch chain joins door and bridge in model.

At right: A craftsman lifts one of the removable walls of an inn, called the Gilded Beaver Tavern in the movie. In his left hand are tiny ale casks, one of the interior props used in the picture. Miniatures of goods that were traded to the Indians for furs are glued to the shelves. The come-apart construction reveals how almost any sort of camera shot can be studied. As *Unconquered* is in Technicolor, all parts of the miniature set were painted to resemble the full-size version. Even ocean-going ships and river boats appearing in the film were first mocked up in 1/24-size models. Below: An interior shot of the tavern, as it appears in the film.





'itz Water Wheel Co.

'his 4" impulse wheel, built for war requirements, 'as direct-connected to a small generator. It can e run off an ordinary water faucet. Note the re- ıovable nozzle and the tiny bucket, lower right.

ıll occurs in the shortest length of stream. ıch a site is often indicated by a natural aterfall, by a conspicuously steep slope, by the swiftness of the current. The cond locating principle is a simple matter cost: a dam should be placed where it ı be smallest and still impound the most ter. This means, in general, that it should placed where the stream valley or cut ıarrowest.

The site of the water wheel, Fig. 2, may either at the dam or some distance below The former location is the more com- ı, being simpler to build and eliminating need for a pipe or penstock to deliver er to the wheel. Disadvantages include fact that the spillway must be of ample city to protect the powerhouse in time igh water, and the fact that only the ficial head"—that created by the dam —is available. In cases where the ıd falls away abruptly below the dam the "divided-flow" layout may be de- e, for it greatly increases the head.

other preliminary calculation should ade the height of the proposed T ted, as a rule, only by walls at the site, pment, and money The higher it is

pond that will be created. "Pondage"—water stored for use in times of peak demand—is an important factor in water-power calculations. Power is rarely needed 24 hours a day, and construction of a dam of sufficient height to provide water storage will greatly increase the power available at the time of day required.

If, for example, a wheel is to be run for 16 hours a day, and if a dam is built that will impound all water flowing into the pond during the idle eight hours, the power capacity will be increased by 50 percent. Don't neglect to distinguish between "live storage"—the volume of water represented by the difference in height of the spillway flash boards and the wheel intake—and "dead storage"—the volume of water below the level of the wheel intake. The former is power banked against a time of need; the latter is worthless, powerwise.

Once the dam and powerhouse are tentatively sited, and the height of the first is provisionally set, it is time to measure the power available. Assume that all w ter flowing in the stream can be made to through the wheel, which is a fair ass tion on small installations. This flow in the power formula) can be determ by the "weir method," which involves constructing a temporary dam of controlled proportions and which will be detailed in a subsequent installment, or by the "float method," which is theoretically a trifle less accurate, though still quite satisfactory.

The float method (Fig. 3) involves the formula:

$$Q = A \times V \times 60$$

in which Q is the volume of water flowing in cubic feet per minute, A is the cross-sectional area of the stream in square feet at the site, and V is the average velocity of the stream at this point, expressed in feet per second.

Select a length of the stream that is fairly straight, with sides approximately parallel, and unobstructed by rocks or shoals for a distance of about 100′. Stretch a taut wire squarely across the stream near the middle of this length and measure the width of the stream here in inches. Mark this width off on the wire and divide it into ten equal divisions. From the center point of each division, measure the depth of the wat in inches. Then average the depth figure by adding each value and dividing by 1

stream can deliver many times this minimum.

The power available at the site of a water wheel (that is, before deductions for inefficiencies in the wheel and generator) is expressed in this formula:

$$\text{Hp.} = \frac{62.4 \times Q \times H}{33{,}000}$$

Here Q is the cubic feet of water passing through the wheel in one minute; H is the "head" or vertical distance in feet through which the water falls; 62.4 is the weight in pounds of 1 cu. ft. of water; and 33,000 the number of foot-pounds per minute in 1 hp. A number of methods exist by which the variables Q and H can be determined, but before considering them, it's well to examine first the possible sites for the dam and wheel, since they will necessarily affect the amount of head secured.

The location of the dam, as suggested in Fig. 1, should be governed by two principles. It should be placed where the greatest useful head is obtainable, that is, where the greatest

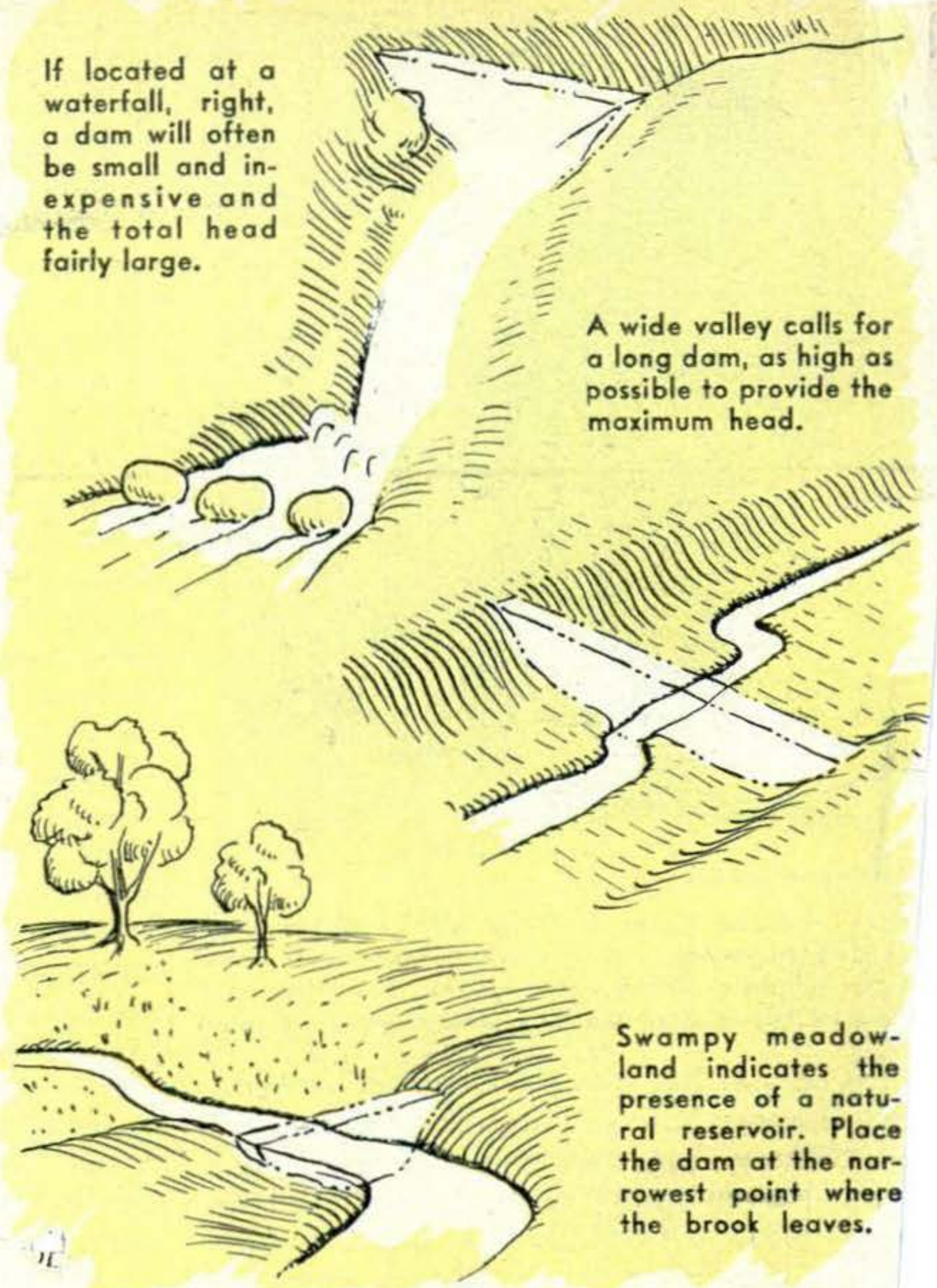
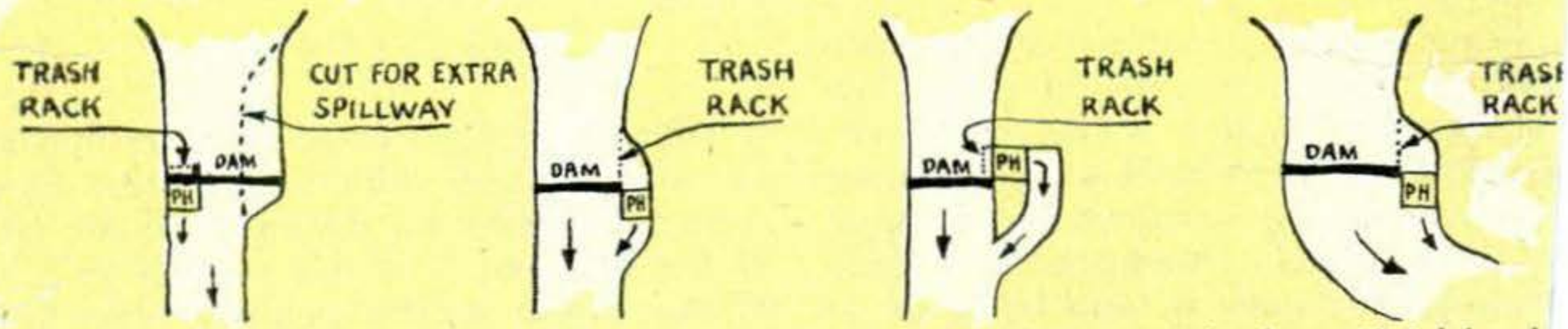
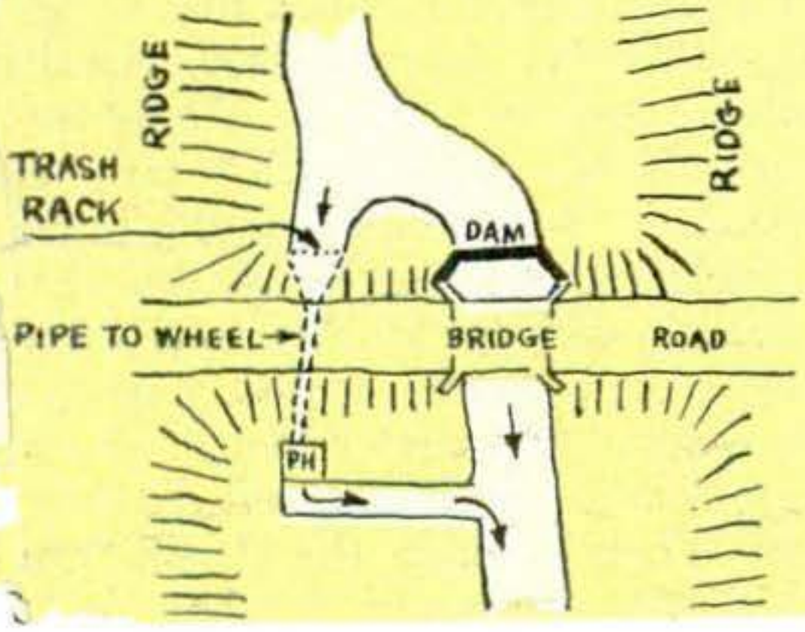


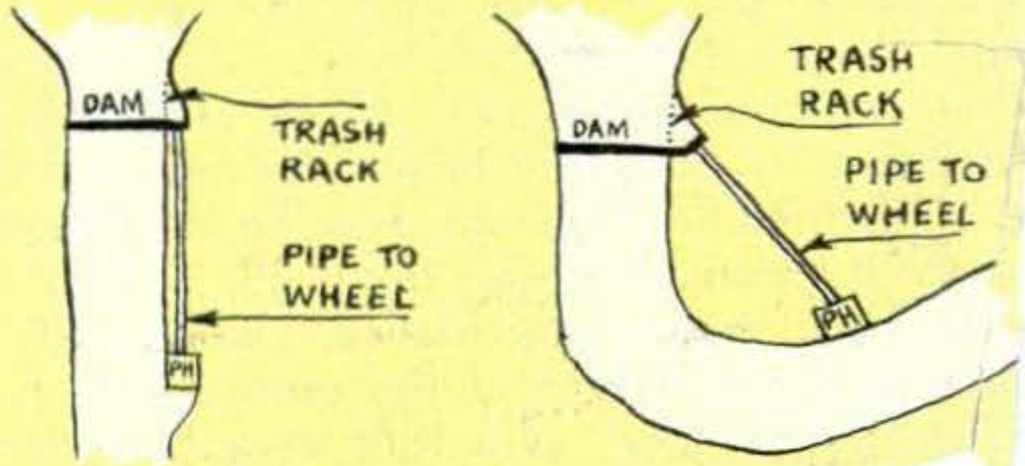
FIG. 1. LOCATING THE DAM

FIG. 2. LOCATING THE WHEEL

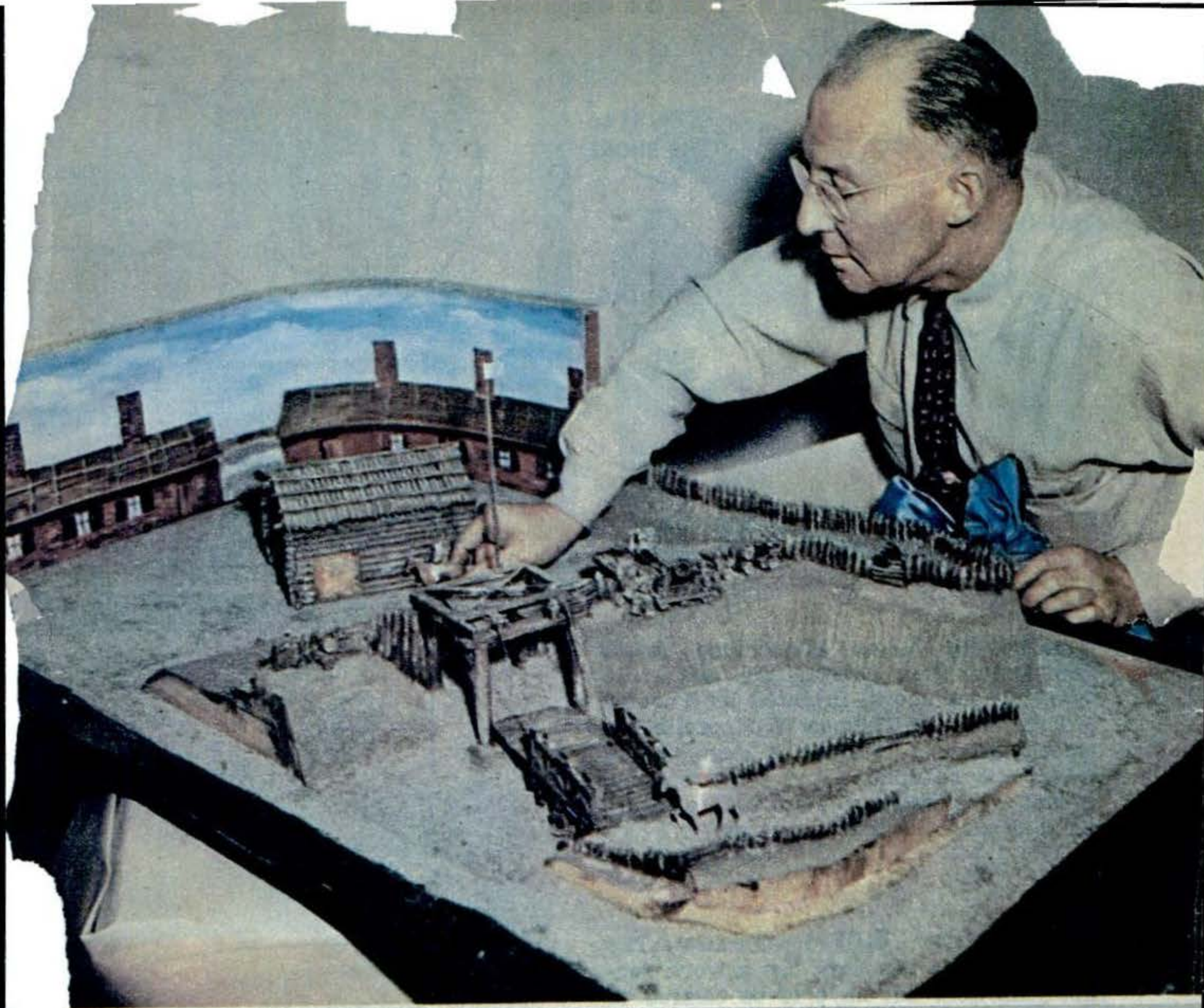


Typical layouts with the powerhouse at the dam, a location that uses only the artificial head.





Typical "divided-fall" layouts, with the wheel ... dam, which add the natural to the artif...



According to historical research, this is how Fort Pitt, situated at the forks of the Allegheny and the Monongahela rivers, appeared in 1763. The buildings painted on the backdrop depict barracks for troops. The miniature-maker is putting a model horseman in position—one of many steps required in planning a particular scene.

Miniature Fort Guards Movie Budget

NOTHING spills dollars out of a movie producer's budget bag quicker than delays on the set after his cameramen have begun shooting the actual picture. So now, borrowing a practice increasingly favored by progressive industrialists, producer Cecil B. DeMille first builds his studio sets to scale in miniature so he can plot definite scenes, action and camera angles long before the cast and the technical staff for a picture go on the pay roll.

Recently DeMille had a scale-model, diminutive Fort Pitt built in Hollywood, and he studied it thoroughly before starting to film *Unconquered*. The model of the colonial fort's houses, fortifications and bridge was built 1/24 the size of the actual studio set. Its structures had removable parts that were lifted out for planning interior scenes and shots in the film's version of the 90-day siege of the fort in 1763, during the French and Indian War. Fort Pitt was built on the site of the modern city of Pittsburgh.

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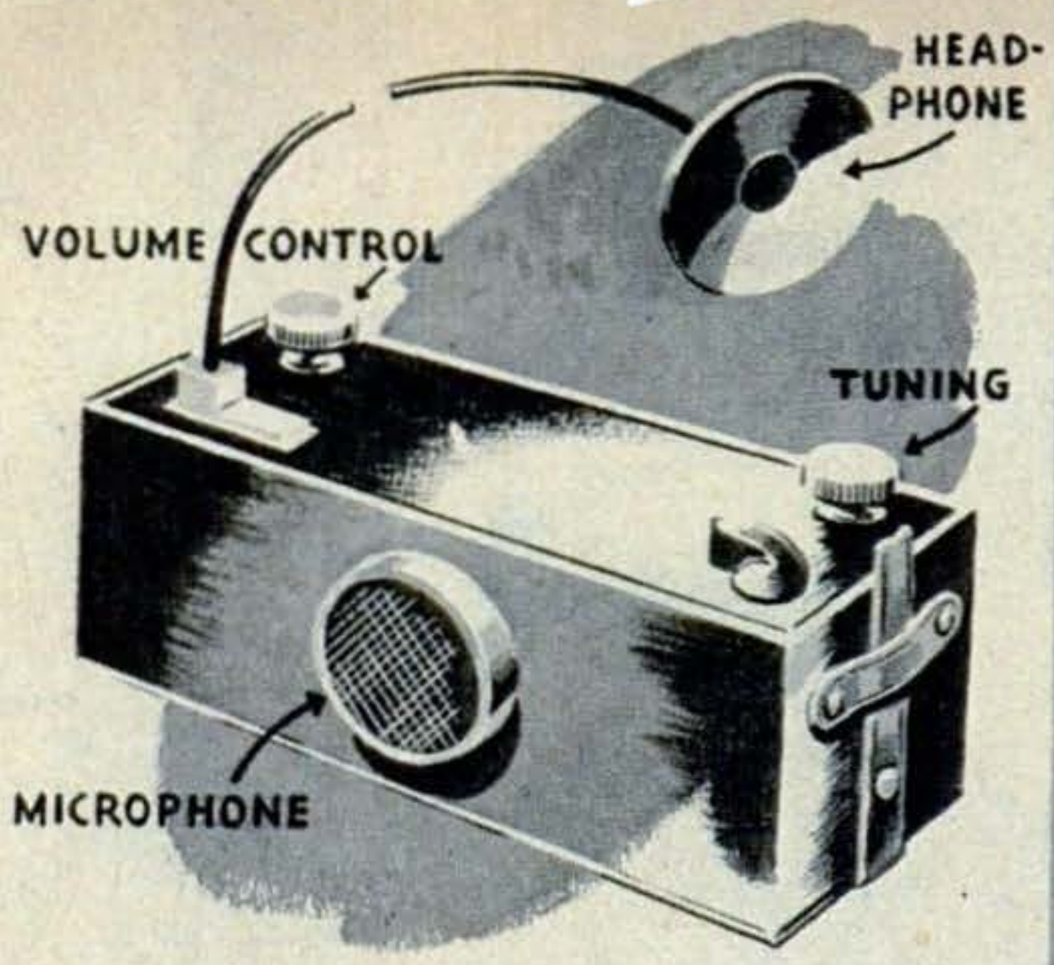
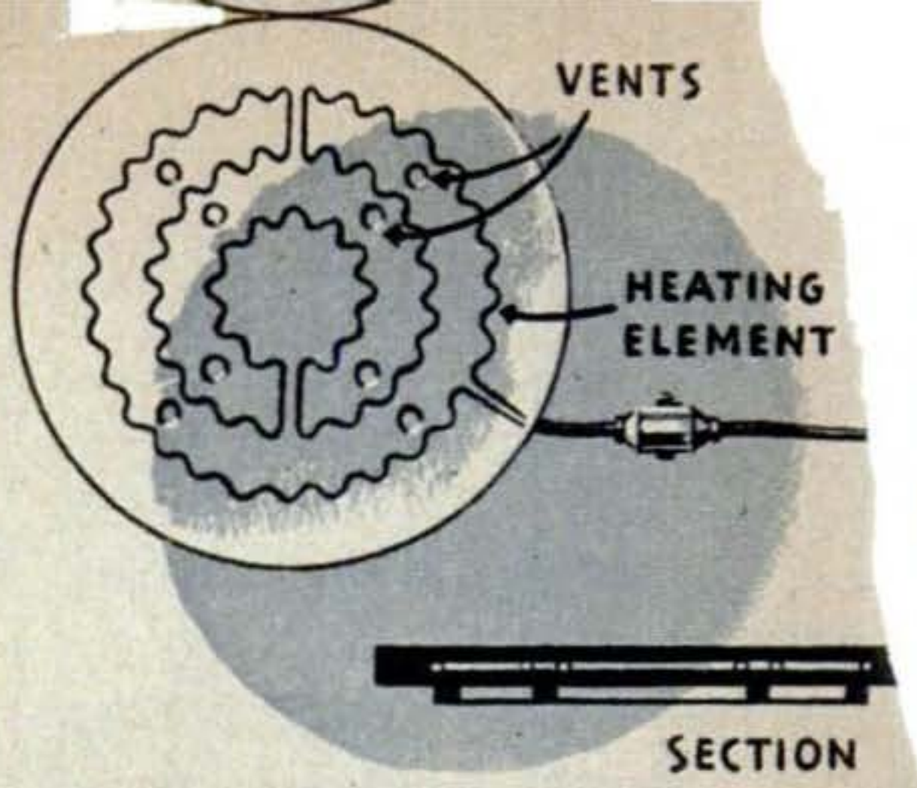
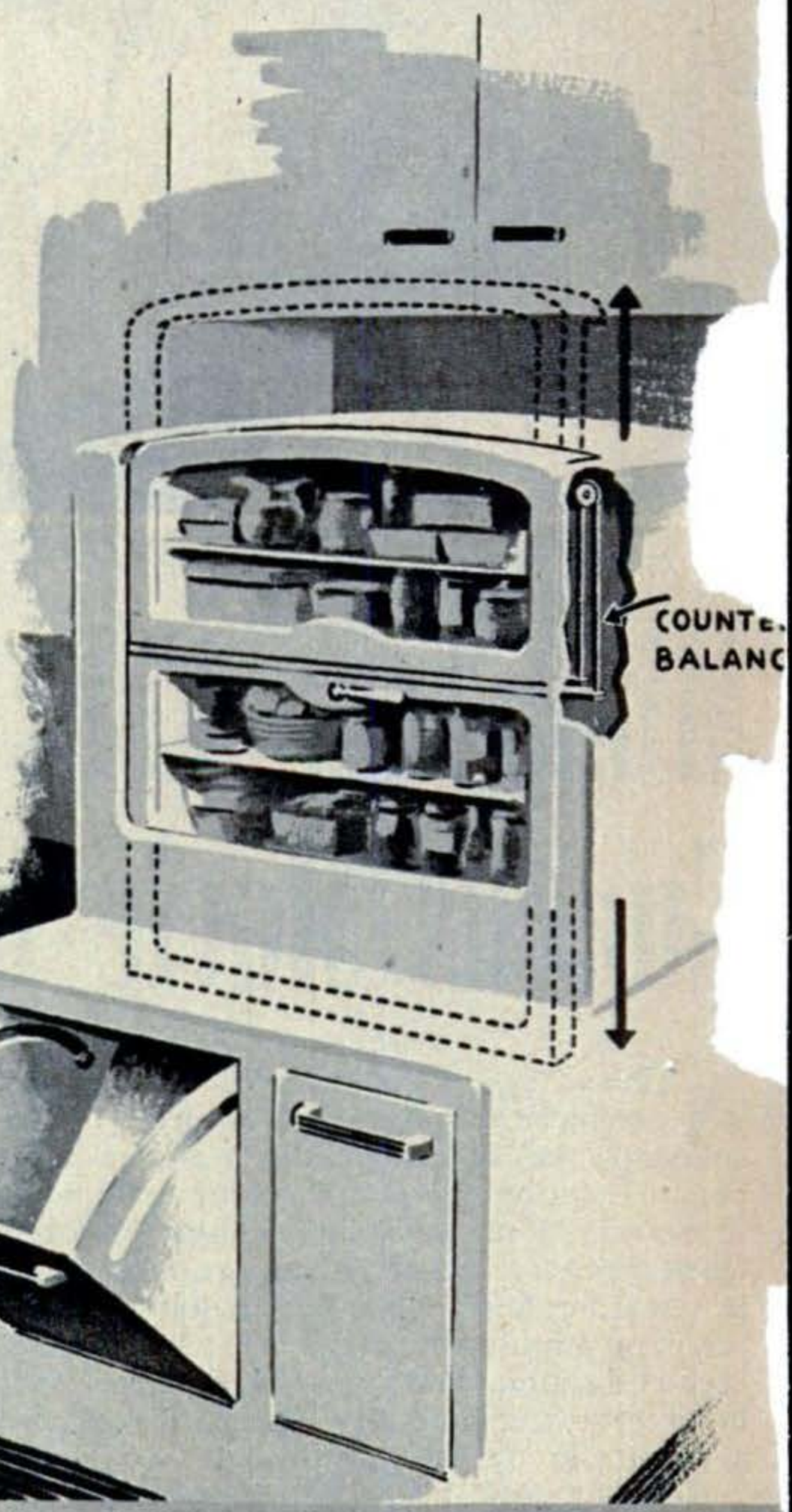


Radio Is Also Hearing Aid. The combination hearing aid and radio receiving set above, invented by Thomas B. Fordham and Thomas W. Moore, has a superheterodyne receiver, a built-in loop antenna, a headphone and a microphone, so that two persons who are hard of hearing may also use it to converse.



Hot Plate Made of Glass. By embedding circularly arranged wire coils in Pyrex glass, inventor John Bilan has devised a novel electric hot plate. The holes in the plate provide draft.

Worktable Refrigerator. The refrigerator at the right has a work surface that does not have to be cleared to open any of the four doors of its compartments. The door of the top compartment slides upward and the door of the one underneath it slips downward when a handle on the front of the refrigerator is moved. The other two doors are under the work surface. It was invented by Harold Van Doren.



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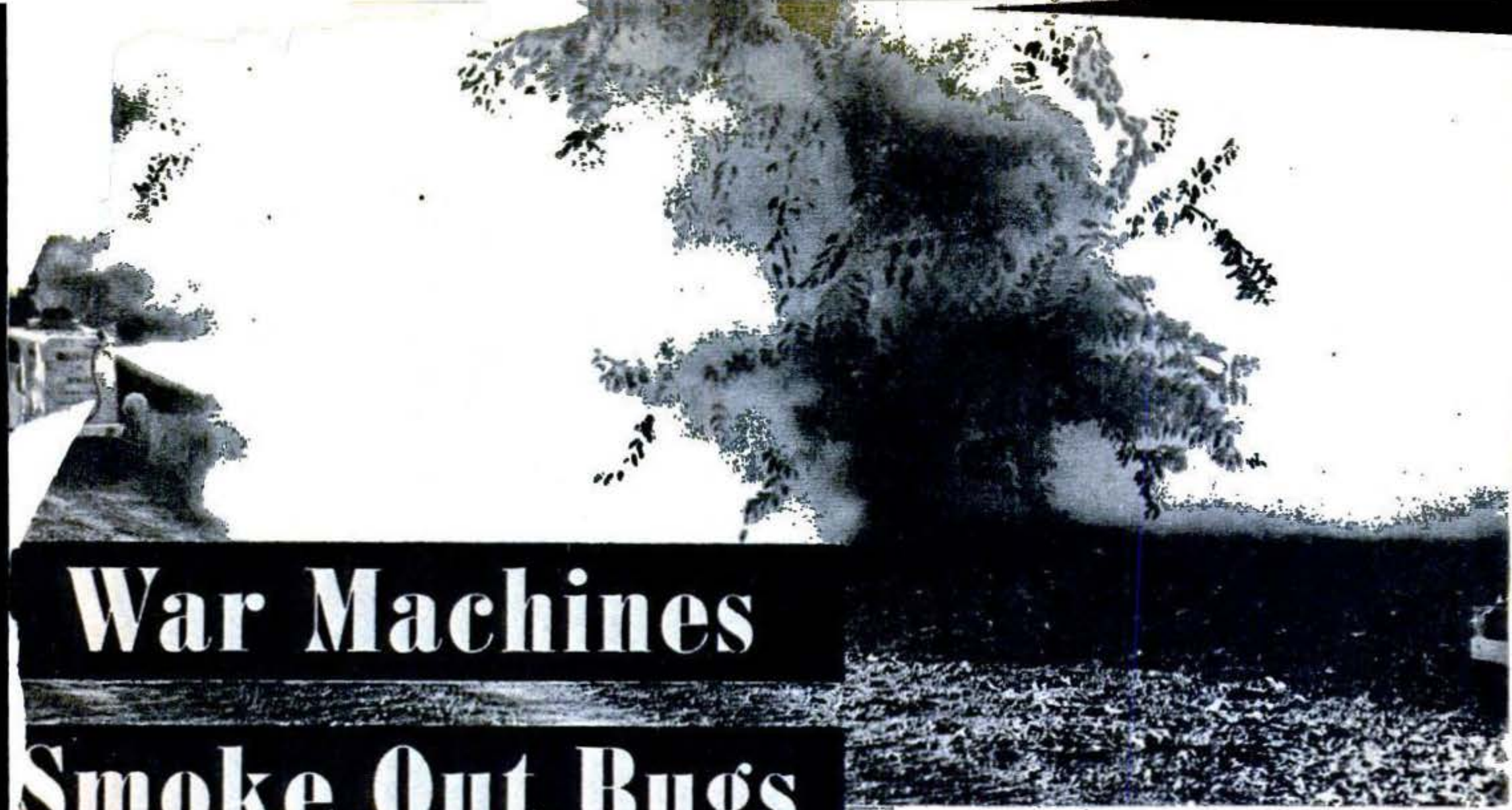

War Machines Smoke Out Bugs

In action at top of page, Bes-Kil generates a fog of poison that settles on leaves in minute droplets to wait for bugs. The box-like fog maker rides on two rubber-tired wheels and is towed by tractor or truck.

Commercial firms are not alone in developing the M2 principle for agriculture—the Army is in there experimenting, too. At right, Howard E. Norton, an engineer with the Chemical Corps Technical Command, operates a converted M2.

Below, (left to right) E. W. Surber, Department of Interior; H. H. Stage, Department of Agriculture; W. D. Reed, Office of Chief of Engineers, and Brig. Gen. E. F. Bullene, of Edgewood Arsenal, Md., examine Japanese beetles slaughtered in M2 test.

FOG generators that helped defeat the Axis today have been converted to wage war on the hordes of parasites that annually try to eat the American farmer out of barn and field. Now on the job poisoning insects and larvae by the acre is the Bes-Kil Aerosol Generator, a direct descendant of the Army's M2, which vaporized oil with heat to throw up "smoke" screens. In Bes-Kil, built by the Besler Corp., which developed M2 with the Army, water is pumped through a series of coils and heated. The resulting steam then atomizes the insecticide at the machine's nozzle and spews it out on orchards and fields, barns and sheds.

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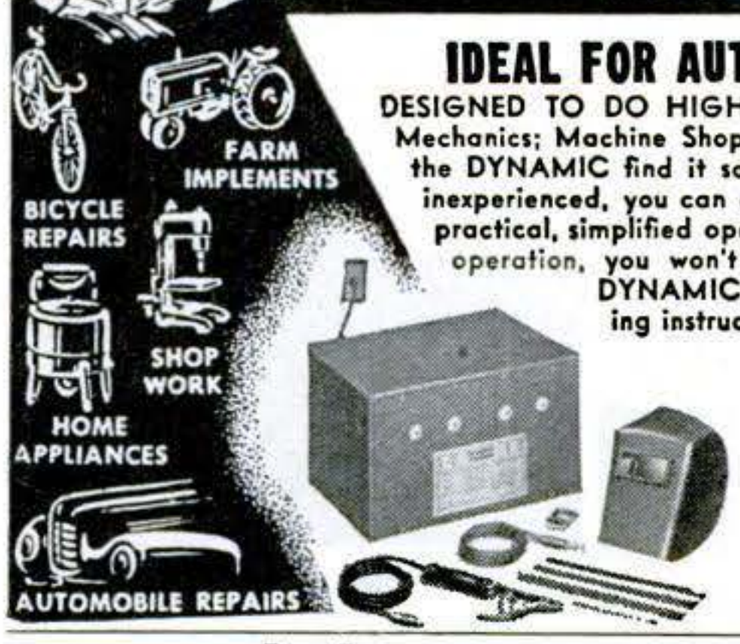

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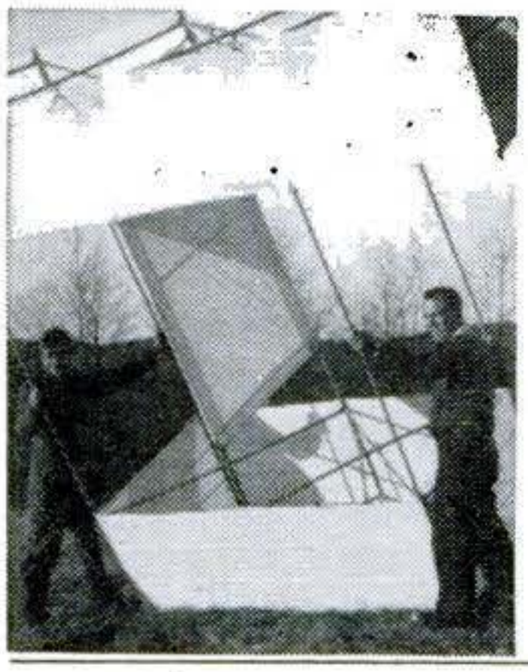

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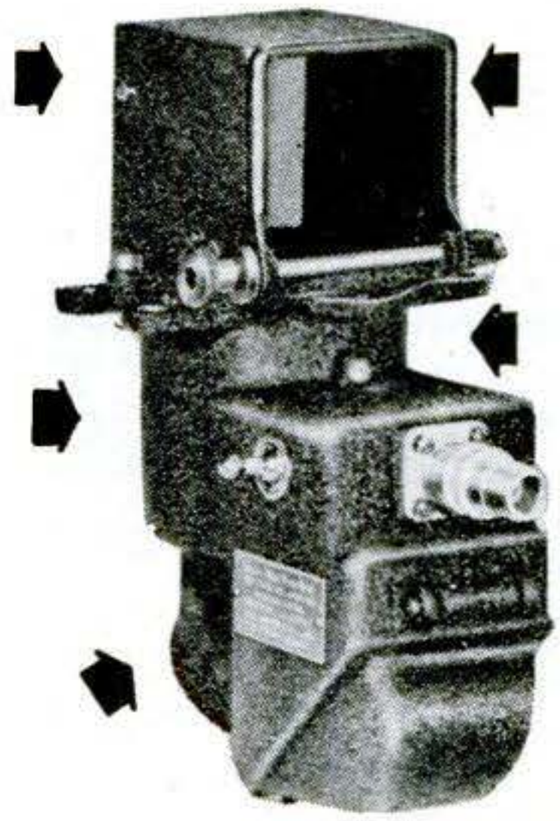

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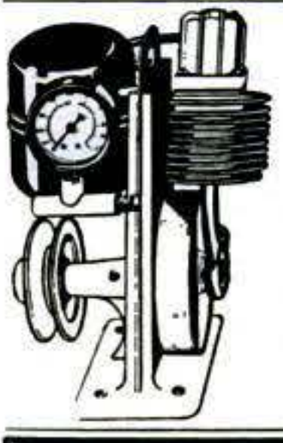

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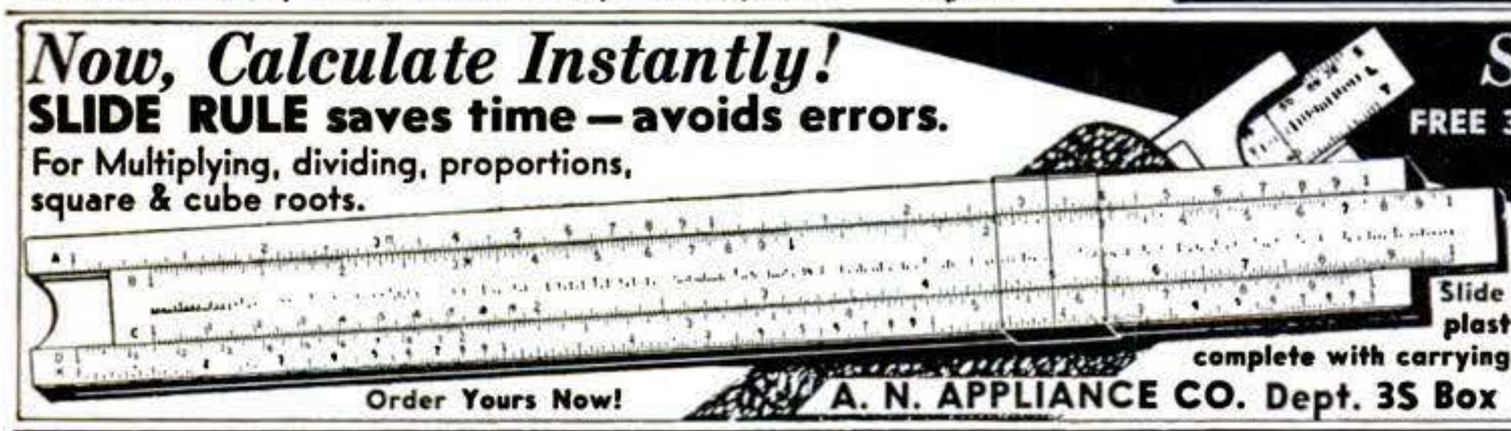

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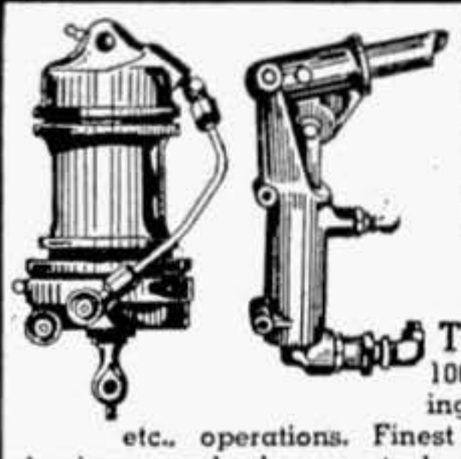

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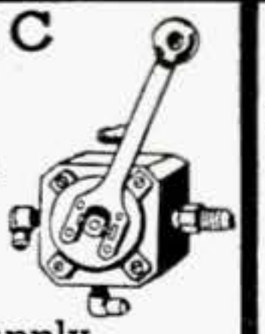

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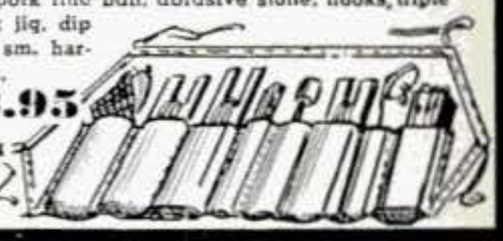

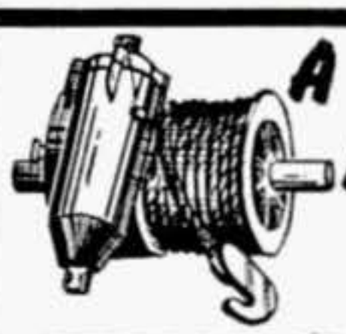

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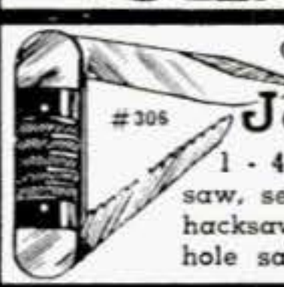

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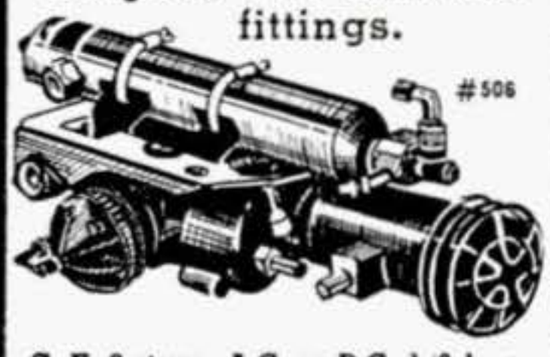

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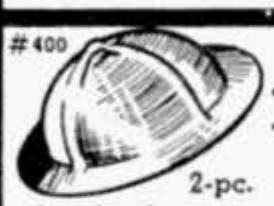

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TO: Reader
FROM: Editor

Is There an ELECTRONICIAN in the HOUSE?

AT LEAST once a month the people who put *Popular Science Monthly* together get a feeling that a magazine editor and a microbe under a microscope have a lot in common. That feeling comes when the latest issue of PSM has had time to reach its readers—and when you and the three and a half million other readers have had time to examine it.

At that point, everything we have put into the magazine comes under some of the most expert scrutiny in the world. Scientists, technicians, machinists, workshop craftsmen, students—all go over our pages with the merciless eye of an income tax accountant.

Scientists and students check the accuracy of the theories and facts we present; technician and mechanic apply the drastic test, "Does it work?" No matter how unusual the subject, there always seems to be a jet pilot, a knitting-machine repairman or a physicist around. When we slip—as we sometimes do—they are standing by with the proper deduction, the correct dimension, the exact what-makes-it-tick.

Their expert and uncompromising corrections, presented every month in the "Letters" column, are an important addition to the information that makes PSM a handbook of what's-new and how-it-works. Here, to emphasize the point, is this month's grist:

Sir:

"How to Drive a Locomotive" (December) you state that the reversing screw is turned left to shorten piston stroke. A piston is connected to the main crankpin by means of a crosshead and the main rod. Therefore, piston stroke cannot be shortened. By turning the reversing screw, you shorten valve travel.

F. F. MALLORY

Conneaut, Ohio

Sir:

. . . Your item entitled "Mine Dress" (December) says, "The respirator allows normal breathing for an hour if the miner is cut off from air." . . . It is not in any sense a breathing apparatus; instead, through the reaction of a chemical called Hopcalite, it transforms deadly carbon monoxide into harmless carbon dioxide. If you had preceded the word "air" with the word "pure" the sentence would have been substantially correct.

N. R. CHILLINGWORTH

Pittsburgh, Pa.

Sir:

After 24 years as a fixer of knitting machines, may I suggest that the paragraph at the bottom of page 132 in "How Nylon Yarn Is Made" (December) should read 16 pairs instead of 32, and on machines 55 feet 2¼ inches or 55 feet 10 inches length over all, depending on the length of the narrowing rack screws?

WALTER A. SIMOND

Franklin, N. H.

Sir:

. . . In the glossary of Fire Department terms (January) there were many that are not used in this department. Also the wrong meanings. For instance, "Over your head and all around" is used in the initial stages of an attack in the interior of a building or ship. . . . The "First Whip" is generally the oldest and best chauffeur or pump operator. . . .

JACOB DUBINSKY

New York, N. Y.

Sir:

Can you look me square in the eye and say that wood is machined to tolerances of .0001 inch, as you did in "Wood Carvers for the Air Age" (December)?

JACK HARVEY

Tarkio, Mo.

(Some woods—ebony, lignum vitae—are; not pine and plywood, as stated.)

It's quite a responsibility, trying to keep ahead of experts in every field. And while it's like working in Macy's window with all lights on and passers-by studying your handiwork day and night, it's a responsibility PSM's staff is proud to bear. Because keeping ahead of experts, and passing on their reactions when we don't, makes a better magazine.

John Stearns

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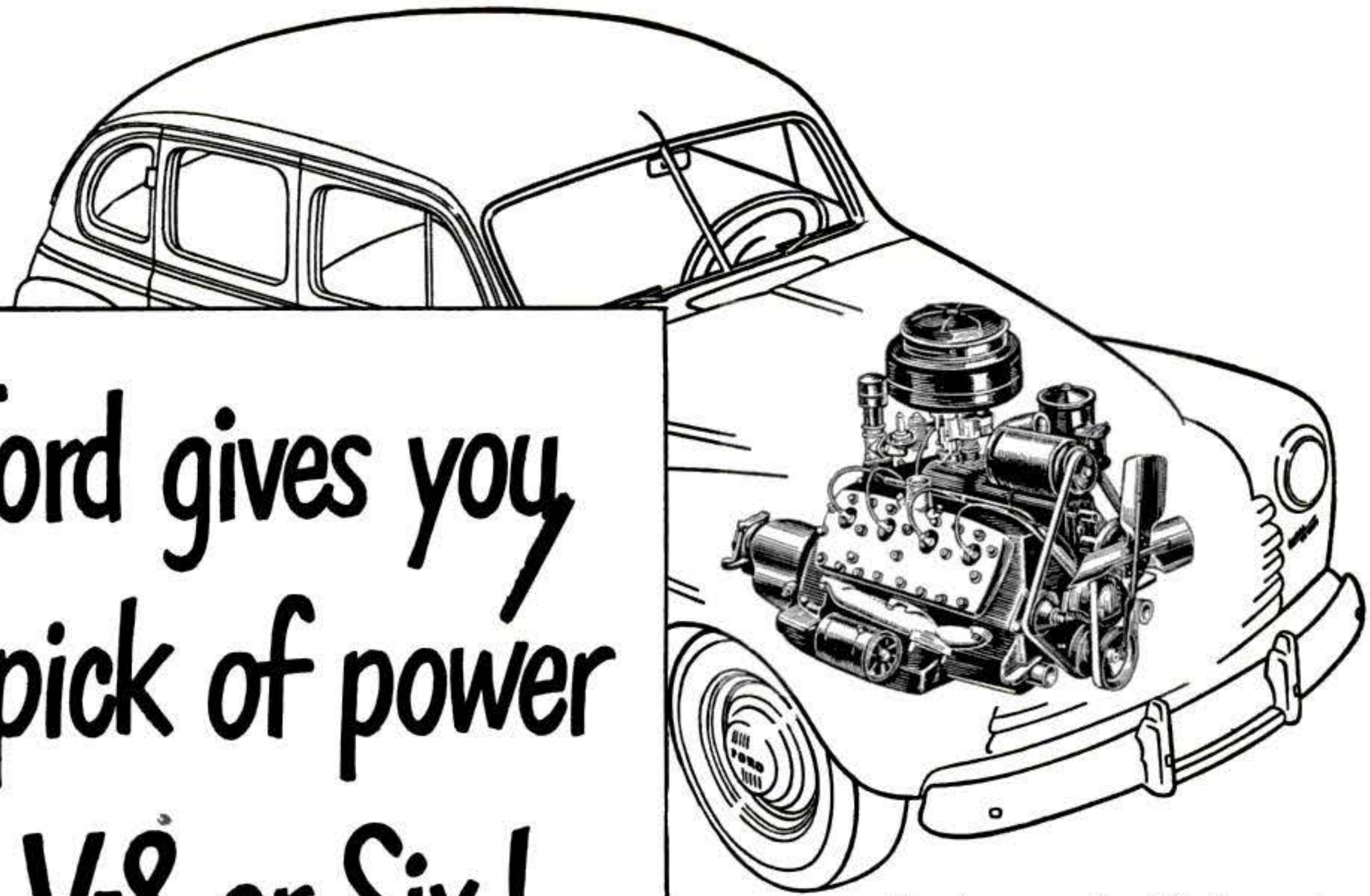
Ford gives you a pick of power ...V-8 or Six!



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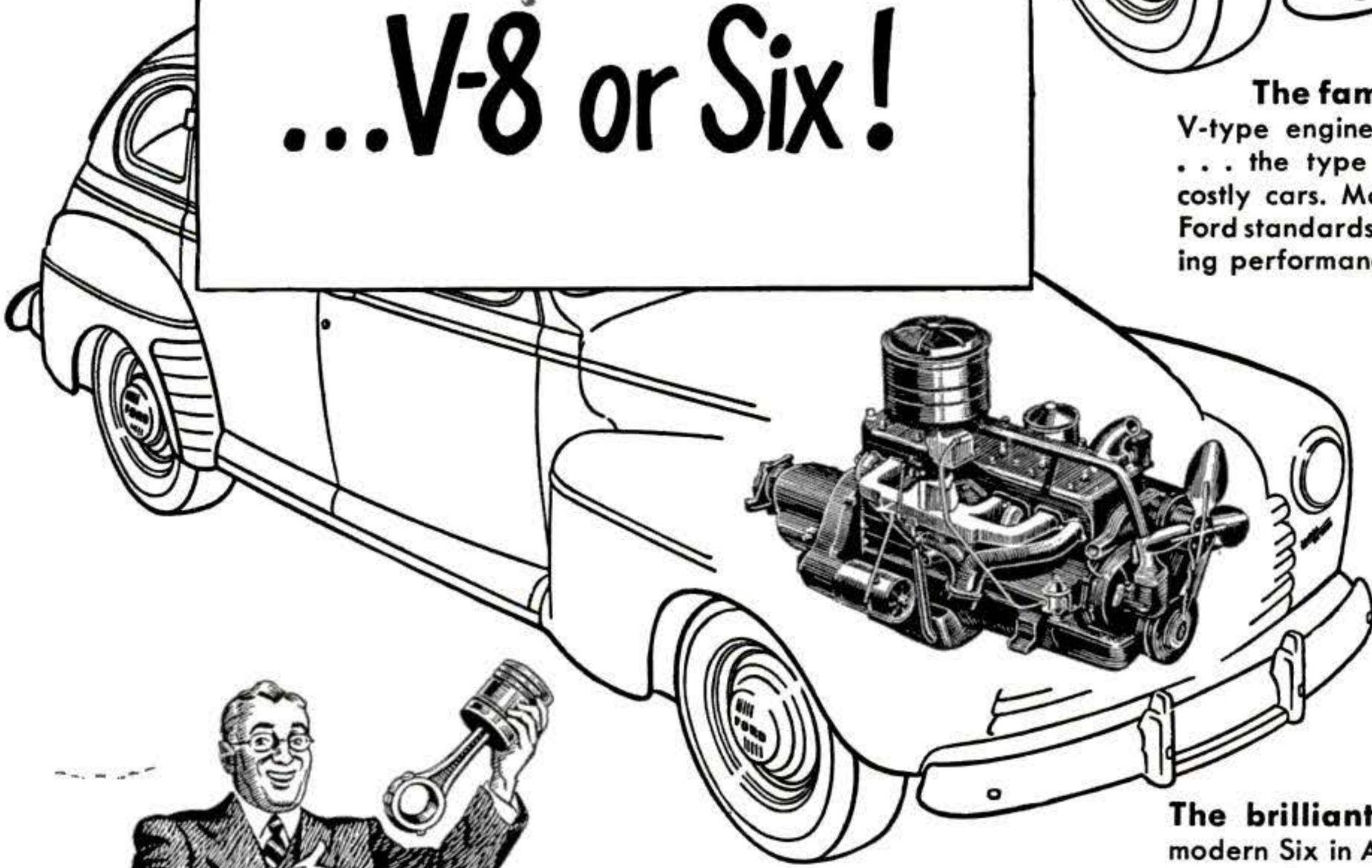

Both have new 4-ring pistons that save on oil. Lightweight aluminum alloy construction gives higher heat conductivity, reduces bearing loads. That means better performance, less wear.

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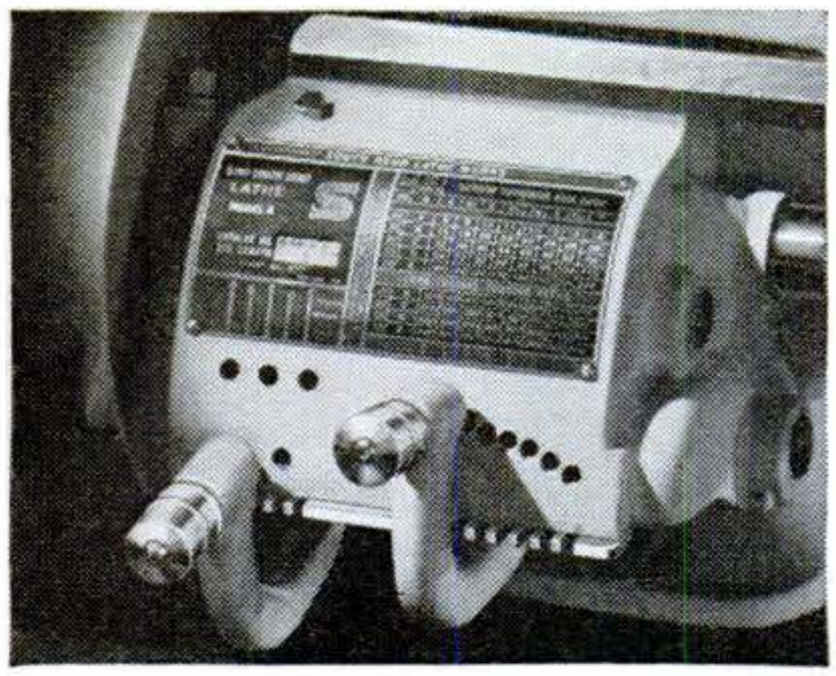

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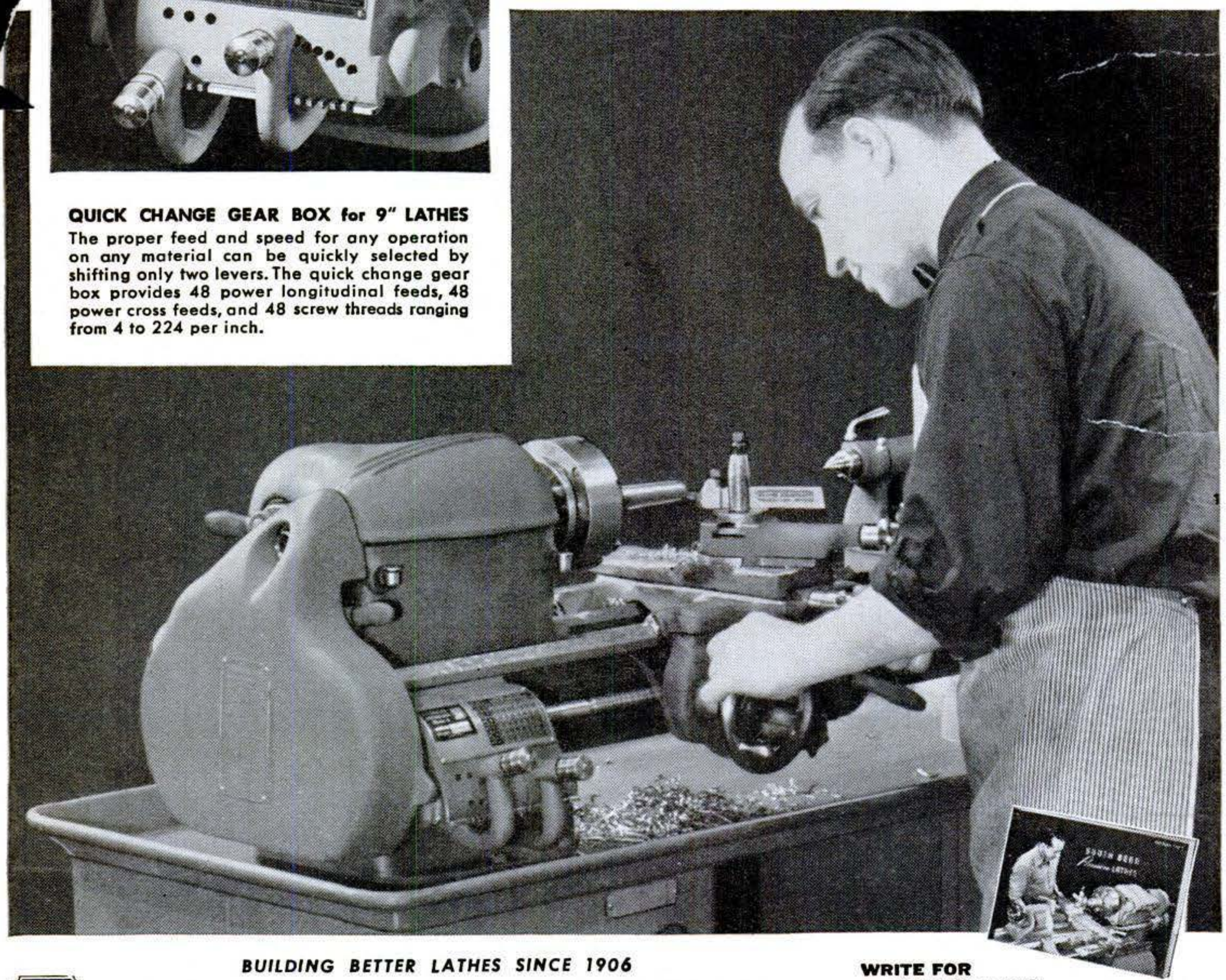

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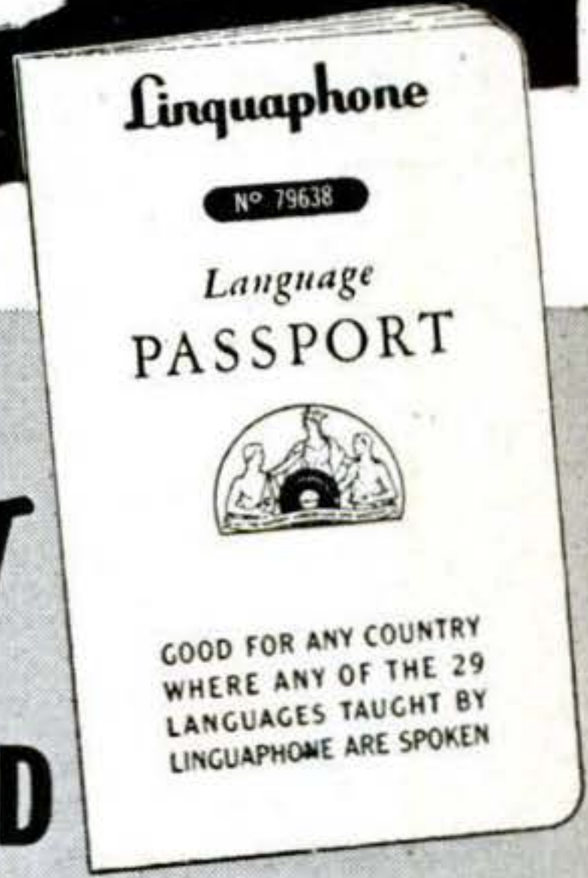

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